SCIENTIFIC AMERICAN

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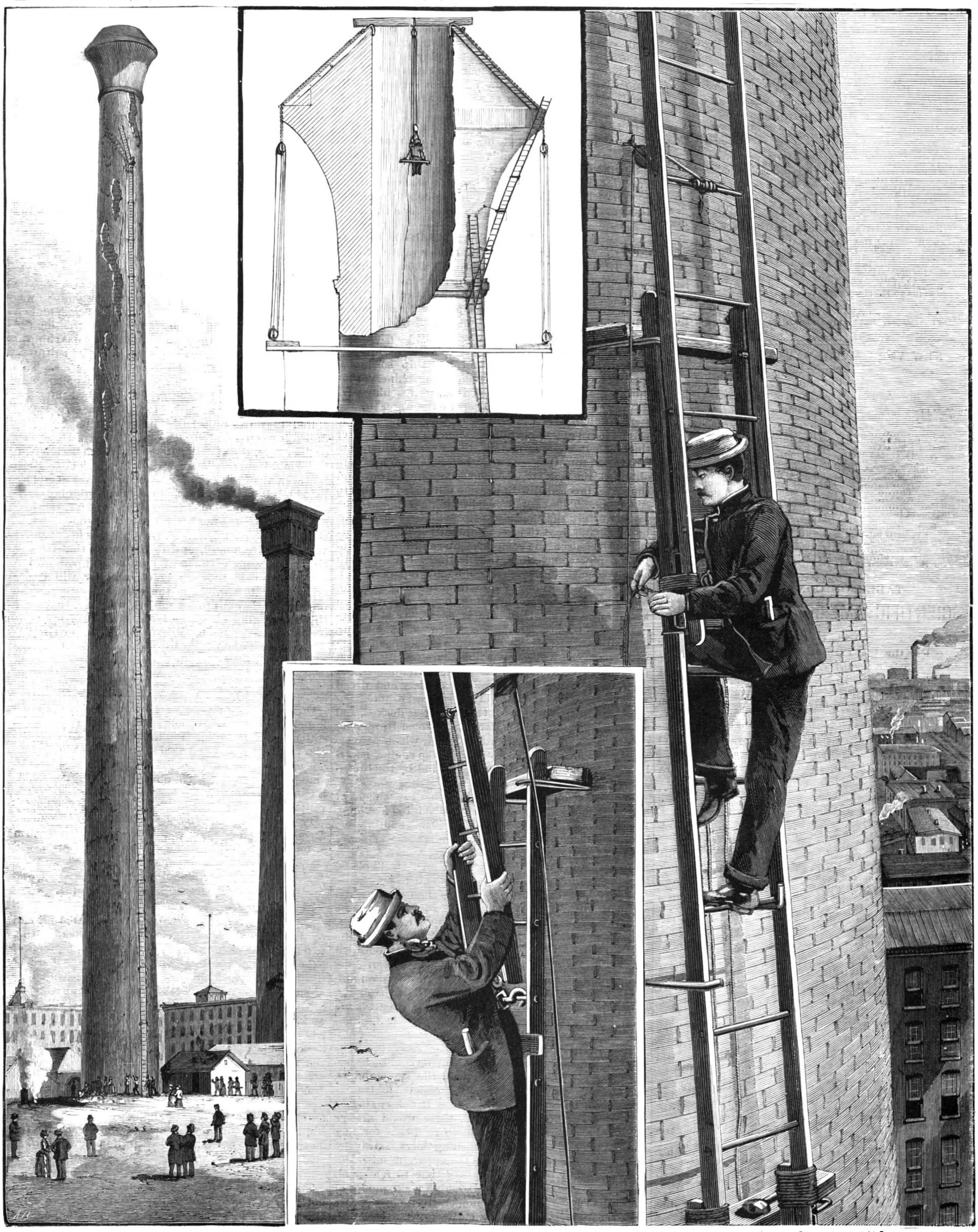

CLIMBING THE GREAT CHIMNEY OF THE CLARK THREAD WORKS AT HARRISON, N. J.—[See page 246.]

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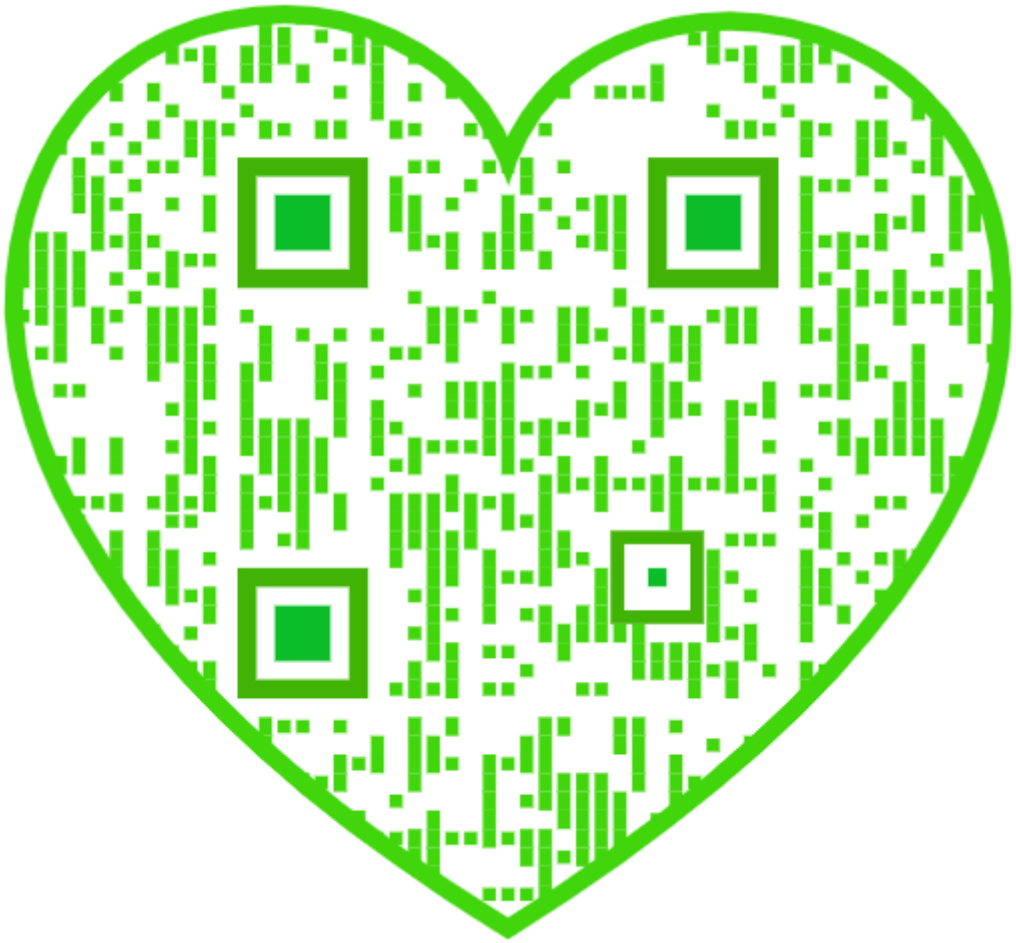

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Contents.

(Illustrated articles are marked with an asterisk.)

Accident to steamer... 242
Belting and pulleys, economy*.. 247
Books and publications, new..... 251
Camphor..... 242
Carnations, perpetual..... 244
Charter Gas Engine Co. 244
Chimney, Clark Thread Works* 241, 246
Coupling, thill, Schoch's*..... 245
Curves, magnetic..... 248
Eugenol..... 246
Eyes, defects in..... 243
Flume, steel.... 250
Fluorine*... 249
Gas, natural, in Indiana..... 247
Houses, cold and damp.. 243
Inventions, index of..... 253
Inventions, recently patented... 251
Kerosene as a medicine..... 247
Kite as life saver..... 247
Lard, preservation of..... 245
Light, arc, improvement... 242
Light, arc, Saunderson's..... 243
Lock, permutation, Lawrence's*. 244
Machine, ditching, Carter's*.... 245
Machine, mitering, Murphy's*... 249
Majestic, steamship..... 242
Maple, sugar..... 247
Mirrors, Japanese..... 250
Mosquitoes, destroying..... 245
Motor, spring, Reichard's*..... 244
Notes and queries 252
Phonograph, scientific use*..... 248
Phosphorescence..... 245
Plug, pipe, Nonpareil* 245
Power, distributing, means of*.. 250
Power, transmission, electrical.. 244
Quinine, substitute for..... 242
Skylight, Campbell's*..... 245
Tool, garden, Stiles'*..... 244
Typewriter, Durrin & Sheldon's* 244
Well, whistling..... 247
Wheel, perforating, Jensik & Stoll's*..... 245

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 746.

For the Week Ending April 19, 1890.

Price 10 cents. For sale by all newsdealers

PAGE

I. ASTRONOMY.—Nebular Hypothesis.—A contribution to a much discussed problem in cosmical philosophy..... 11921

II. BIOGRAPHY.—Thomas Alva Edison.—Biographic note and portrait of the great inventor.—1 illustration..... 11911

III. CHEMISTRY.—Hydrogen Lamps.—A self-igniting lamp made from a pickle bottle.—1 illustration 11925

Eikonogen.—By RAPHAEL MELDOLA, F.R.S.—The chemistry of the new photographic developer.—Some valuable contributions to the higher science of photography..... 11925

On the Formation of Ozone, Hydrogen Peroxide, and Nitrous Acid as Products of Combustion, and on their Presence in the Air.—A very interesting investigation of this subject, with full details of the method of attack adopted and the results of the lengthy investigation..... 11924

Sulphureted Hydrogen Generator.—By W. OAKES KIBBLE.—A simple and novel form of gas generator, of low cost, and very advantageous features.—2 illustrations..... 11925

IV. CIVIL ENGINEERING.—The Vibratory Motions of Rails.—A very curious piece of apparatus, and remarkable results attained by its use in showing the phases of the tendency of rails to displacement.—3 illustrations..... 11922

Thirty-five Ton Accident and Construction Crane.—A steel and iron crane for use on railroads, worked from a platform car, with tender and manipulating engine.—Illustration showing the lifting of a loaded car.—1 illustration..... 11922

V. ELECTRICITY.—Electric Oscillations in Rarefied Air without Electrodes.—By JAMES MOSER.—An examination of the properties of the absolute vacuum, with demonstrations of its non-conductivity..... 11914

Miners' Electric Lamp.—A very compact and neat lamp supplied by a four-cell accumulator.—3 illustrations..... 11914

The Fiske Position Indicator.—The application of electricity to gunnery.—Lieut. Fiske's recent invention for training heavy guns upon distant objects.—2 illustrations 11915

The Laying of Submarine Cables.—By HERBERT LAWS WEBB.—An exceedingly graphic account of the operations of laying cables at sea, with incidents drawn from actual experience 11912

The Protection of Chimney Shafts from Lightning.—By C. MOLYNEUX and J. M. WOOD.—A full statement of the requirements for protecting lofty chimneys from lightning, of special interest in connection with the injury done by lightning to the Clark chimney in Newark..... 11915

VI. MECHANICAL ENGINEERING.—Notes on a New Compound Steam Turbine.—A steam turbine using and compounding its steam six times over, giving 10 horse power with a weight of but 68 pounds.—3 illustrations..... 11918

VII. MEDICINE AND HYGIENE.—Infantile Diarrhea.—A new treatment of this troublesome complaint, with results..... 11926

Treatment of Dandruff.—The removal of dandruff from the head, a series of prescriptions given from personal experience..... 11926

VIII. MISCELLANEOUS.—A Steam Tricycle.—A new attempt at steam locomotion, the invention of Serpollet, the inventor of the well known steam generator..... 11923

IX. NAVAL ENGINEERING.—High Speed in Ocean Steamers.—By B. SCHIELDRAP, C.E.—An examination of the science of speed at sea, giving coefficients of fineness for different classes of ships, and developing the contrast between the new theories of skin friction and the wave line theory of SCOTT RUSSELL..... 11923

X. PHOTOGRAPHY.—A Machine Camera Taking Ten Photographs a Second.—A camera of probable use in military operations for photographing the different phases of a battle, or in ordinary life of a man speaking an oration, and of similar subjects.—3 illustrations..... 11921

XI. TECHNOLOGY.—A New Ice Machine.—An apparatus for the production of ice by the use of ammonia.—Results and general data.—2 illustrations..... 11919

Differential Pyrometer.—An apparatus for use in different factory operations where a specific temperature has to be maintained.—1 illustration..... 11919

Drying in Vacuo.—By Mr. EMIL PASSBURG, of Breslau.—A valuable paper on this subject, one of increasing importance, with descriptions and illustrations of plant and its manipulation.—4 illustrations..... 11916

The Cheshire Salt Works.—An interesting contribution to technological science, describing the manufacture of salt in England.—8 illustrations..... 11920

The Lincoln, Neb., Paving Brick Works.—The manufacture of a new paving material, a description of the works and of the different steps of the process..... 11916

THE MAJESTIC.

Another new and magnificent ocean steamer, the Majestic, of the White Star line, arrived in New York from Liverpool on the 9th inst., after a fast passage—6 days and 18 hours. This ship, like the Teutonic of the same line, is 582 ft. long, 57½ ft. wide, 39 ft. 4 in. depth, 9,685 tons tonnage, built of steel, two independent sets of triple expansion engines, twin screws, engines of 17,000 horse power, 12 boilers, 72 furnaces. This vessel and also the Teutonic have been built under an arrangement with the British Admiralty whereby the ships are to be taken into the naval service whenever required.

The ships are so arranged that twelve guns can be mounted on each ship forty-eight hours after arrival in port, and it is believed that, with their attributes of twin screws, high speed, and great strength and coal endurance, these two steamers will play an important part in realizing the hope of many in times past of seeing the royal navy and the merchant service bound together in one common scheme for the national protection.

It is a question worthy of serious consideration whether our government might not, with great advantage, offer liberal inducements to our own ship builders to put afloat a class of vessels like these. Not one of our new unarmored cruisers can compete in speed with the Majestic, and it is doubtful if any of them could beat her when she is armed for a fight.

ACCIDENT TO A GREAT STEAMER.

On the 25th ult., at 5:30 P. M., on her outward passage from New York to Liverpool, when about 75 miles off the coast of Ireland, driving along at full speed, the machinery of the steamer City of Paris suddenly broke down, both engines stopped, and the vessel was drifted helpless on the waves. To add to the danger of the situation, the water came pouring into both engine compartments. The accident appears to have been so serious, and the ship so inadequately supplied with steam pumping machinery, that during the four days that elapsed before reaching port the vessel gradually settled deep in the water by the stern, though it is claimed by interested people she was never in any danger of sinking. Two days after the accident she was met by the steamer Aldersgate and towed into Queenstown, where steam pumps were obtained, the leak stopped, the water pumped out, and the vessel proceeded with her one uninjured engine to Liverpool. The captain's telegraphic report to the owners was to the effect that the cylinder of the starboard engine went to pieces, injured the bulkhead between the two engine compartments, and broke the injection pipe connections, thus letting water into both compartments. Passengers on board report that a cloud of steam suddenly rose from the engine room, followed by a terrific grinding noise, all of which lasted for a minute, then all was silent. One passenger says a portion of the machinery was thrown up and fell upon the deck. The ship was amply supplied with boats, the weather was fine, there was little or no panic among the people on board, 1,000 in number, but all were subjected to a strain of anxiety and dread which was not relieved until they stepped ashore.

After arrival at Liverpool the vessel was docked, and as she rose out of the water her starboard propeller dropped off, revealing a broken shaft, which at once explains the cause of the accident to the engine, namely, the sudden jerk given to the engine by the breaking of the shaft.

The City of Paris is one of the noblest specimens of marine architecture now afloat. She is 560 feet long, 10,500 tons burden, 63¼ feet width, 42 feet depth. She has twin screws, worked by two independent engines of the three-crank triple-expansion type, both together having 20,000 horse power. There are 9 steel boilers, 54 furnaces, and 12 fans for supplying air to boilers.

The vessel is supplied with no less than thirty-seven auxiliary engines, most of them operated by hydraulic power, and used for steering, hoisting cargo, stores, ashes, and doing all kinds of work in all parts of the vessel. The ship is supplied in each engine room with two fire and two bilge pumps of the most powerful description, so arranged as to be available for pumping the compartments between the double bottoms of the ship, and also emptying any of the compartments should water come in. The duplicate electric light engines were located in the main engine rooms.

It seems never to have been anticipated that both engines and both engine compartments could ever be simultaneously damaged so that all the steam pumps and electric light engines would be rendered useless. It appears to have been believed that if one engine or one set of pumps broke down, there would always be another engine and pumps in readiness for any emergency, and capable of propelling the vesssel almost at usual speed. Just here was the apparent miscalculation. It only took one minute of time to render all the double engine power and double main pumps of the City of Paris useless and inoperative.

In all first-class American steamers there is an ample supply of independent steam donkey pumps and boilers arranged above the water line. In case of damage to the main engines and pumps, the donkey boilers can be fired and the pumps worked. In the City of Paris this arrangement was done away with in order to make the ship quiet and relieve passengers from the disagreeable sizzling of steam, rattling, and the noises attendant upon the use of a number of donkey engines. It is probable in view of this mishap the City of Paris will now be provided with additional pumps and boilers to meet any such occurrence as the present. The flotation of the City of Paris for four days at sea with two great compartments filled, and all her machinery disabled, shows that progress has been made and that the time is approaching when we may expect to have really unsinkable ships.

CAMPHOR.

The retail price of camphor has recently advanced from thirty to sixty cents a pound. This will no doubt occasion surprise to many persons, and especially to those who will soon require to make small purchases of the drug for the purpose of protecting fur and woolen garments from moths during the summer season.

The scarcity and consequent high price of camphor is caused by the large quantities of it which have been taken by European governments for the manufacture of smokeless powder and also by the increasing demand for celluloid goods both in Europe and in this country.

Previous to the invention of celluloid, about all the uses to which camphor was put were for preserving clothing and fur goods against moths and in medicine. Now the two great inventions above alluded to are using such large quantities of this article that the supply will probably prove to be entirely inadequate. The principal source of this supply in southern Japan was fully described in the last issue of this journal, and on April 3 a plant built in this country for extracting the gum from the wood by improved processes was shipped to Hiogo, Japan, which some think may institute a revolution in preparing the drug for commerce. This plant is composed of stills, engines, and boilers, and when shipped at Pittsburg, Pa., weighed fifty-five tons and occupied two cars. It has been erroneously stated that the object of sending this machinery to Japan is to obviate the necessity of bringing the wood or fiber here, thus paying freight on much useless material and incurring loss by evaporation. The truth is, however, that the camphor wood has never to any extent been brought to this country, the work of extracting the gum being done in Japan, but it is put through a refining process after arrival here. As described in the article above referred to, the processes in Japan are very primitive indeed, and it is possible that the machinery now going forward may be so great an improvement that the supply of camphor will be increased by its use. It is the opinion of those who have given thought to the subject, however, that some substitute will have to be found for camphor in the manufacture of smokeless powder, if not in the production of celluloid, as it will be impossible to pay the high prices which the unusual demand creates.

IMPROVEMENT OF THE ARC LIGHT.

On page 243 we give at some length the details of an improvement in the arc light which, according to the statement of Dr. John Hopkinson, has yielded results of a very important and valuable nature. The luminous power of the ordinary light is asserted to be nearly doubled, less energy is consumed, increased steadiness is gained, the quality of light improved, and other advantages gained. The improvement is effected in a very simple manner, to wit, by feeding to the lower carbon a minute quantity of hydrocarbon, in the form of an oil or grease. The further particulars given will no doubt be read with interest.

Substitute for Sulphate of Quinine.

At a recent meeting of the French Academy of Medicine, Professor Dujardin-Beaumetz stated that he had received from M. Valude, of Vierzon, a paper relating to a new specific for the fever and other symptoms of paludism. This medicament consists of the bark of the panbotano, which is a leguminous tree (suborder *Mimosæ*) of Mexico, isolated plants being cultivated in some parts of Europe. M. Villejean has studied the bark, and found fatty matters, tannin, etc., but no alkaloid or glucoside. M. Valude administered panbotano bark to his patients in form of an alcoholic tincture, and also gave a preparation made by maceration. He preferred the latter, which he made by putting 70 gm. of bruised bark into a quart of water and boiling down to a pint, this being the quantity to be taken in twenty-four hours. In the eight paludic cases described by M. Valude a single dose, or, at most, two doses, caused the disappearance of well-defined tertian fevers.—*Bull. med.; Nouveaux Rem.*

To make waterproof writing ink, an ink which will not blur if the writing is exposed to rain: Dissolve two ounces shellac in one pint alcohol (ninety-five per cent), filter through chalk, and mix with best lampblack.

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Saunderson's Improved Arc Light.

For many years there have been efforts made for the improvement of carbons for electric arc lamps with some measure of success, also for introducing various materials into the arc, but in no case has any important advantage been gained. In many cases certain substances have been ground up and incorporated with the carbon, with the result that ashes or clinkers have been formed to such an extent as to render the light of less rather than greater intensity. The most successful carbons have been those made up with finely powdered soft carbon dust, compacted together by well known methods, which we need not now discuss. A very remarkable discovery has been made which will certainly give an enormous impetus to electric lighting. The inventor, Mr. Llewellyn Saunderson, of Kingstown, county Dublin, while experimenting with the arc lamp in his endeavors to improve its powers to pierce fog, so as to minimize loss of life at sea, determined upon introducing into the arc minute quantities of intensely heated hydrocarbon vapor so as to enrich the light with the well known fog-piercing rays, viz., yellow and red. Having succeeded by this means in producing a beautiful sunshine yellow, he discovered that at the same time the intensity of the light was enormously increased. A plant was put down consisting of gas engine, dynamo, and electric arc lamps, and the question was followed up by introducing various gases into the arc in a number of curious ways, only a few of which can now be described. The first consisted of a jet through which the vapor was projected into the arc; then two jets, and so with a number of other contrivances. The hydrocarbon was vaporized in the tube leading to the jet, and retarded in its passage by asbestos, etc., to give the carbon time to bring the vapor up to an intense heat, and a wick was employed to prevent the vapor from going back, as well as to supply fresh fluid by capillary action. Having thoroughly convinced himself that a substantial improvement of the light could be produced without requiring additional power from his gas engine and dynamo, the inventor now contemplated bringing his new light forward for actual tests against the best light that could be produced by the carbons now universally employed in arc lighting. He made inquiries as to who he should ask to assist him, and Lord Crawford very kindly allowed some temporary tests to be made at the store of the London Electric Supply Corporation in the Adelphi Terrace, but the exigences of the business of the corporation were such that the long and laborious investigations required could not be continued. Subsequently the inventor was recommended to apply to Mr. Apps, 433 Strand, London, so well known for his work in connection with physical science, and after careful consultation it was decided to put down a plant consisting of gas engine, dynamo, storage cells, and two large Brockie-Pell arc lamps, each taking about 45 volts and 12 amperes. This plant began running in May, last year, and was designed and fitted up by Mr. Apps with a full complement of testing instruments of the most approved design. The two lamps were arranged at the ends of a long photometer scale, the photometer being in the center and the lamps vertically placed at each end. The exact candle power of either lamp was not thought to be important, but the precise relation of the lights of the two lamps was the point to be ascertained, the energy to each being indicated by the sets of instruments placed on the walls opposite. At this stage the experiments were greatly extended, and many thousand observations taken, with a general mean result agreeing with that separately and afterward determined by Dr. Hopkinson. It was found, however, that for very exact measurements greater steadiness was absolutely necessary. Having now procured readings of a reliable nature, and of the most extraordinary character, the inventor was advised to call in Dr. John Hopkinson, M.A., D.Sc., F.R.S., etc., to report to him on the power of the new light as compared with the old arc light. A pair of black velvet screens were ordered to be placed behind the lamps, and the whole of the framework also was colored a dull black. The tubes of the photometers were also lined with black velvet, and special arrangements were contrived to get the maximum steadiness of light from the lamps. At this point some measurements were taken which were fully verified subsequently, but the unsteadiness of the light was still a serious source of difficulty. The lamps were now made to rotate in their own frames and to be inclinable at any angle also—the automatic regulating mechanism being entirely removed, and a screw arrangement added for hand regulation. By this means the possible errors due to craters were almost entirely eliminated, and, after taking a great number of readings, Dr. Hopkinson decided to make his report, which is as follows:

THE REPORT OF DR. JOHN HOPKINSON, M.A., D.SC., F.R.S., ETC.

Arc Lamp with Hydrocarbon.

The peculiar feature of this invention is, that the lower or negative carbon is hollow, and is connected with a reservoir of hydrocarbon, as tried by me, Young's paraffin, density 0·865, this oil passes up the hollow carbon into the arc.

The object of my experiments was to ascertain what advantage, if any, resulted from the presence of the hydrocarbon. Two arc lamps were provided, identical in all respects, with the exception that to one of them the invention was applied. The electromotive force and current supplied to each arc were measured by voltmeters and amperemeters, which were afterward compared with each other, and were found to give the same indications for the same currents. The lights given by the two arcs were compared by a photometer generally of the ordinary construction. In a part of the experiments the ordinary Bunsen grease spot was replaced by the so-called Joel's photometer, consisting of two pieces of obscured glass; the results with the two instruments are in fair accord.

In order to diminish the very considerable variation dependent upon the position of the crater, the lamps were inclined so that the axes of the carbons made an angle of 45° with the horizontal, the craters in the two upper carbons facing each other. Between successive observations the lamps were turned through an angle of 180° about the axes of the carbons, so as to reverse the favorable or unfavorable position of the craters. As might be expected, the observations varied very considerably, and the mean of the observations only is given here. In obtaining this mean the whole of the observations are included with the exception of six—three extremely favorable to the new lamp; three, on the other hand, unfavorable.

The final result which I find is this: Mean potential of ordinary lamp, 39·8 volts; of new lamp, 41·4 volts; mean current of ordinary lamp, 12·4 amperes; mean current of new lamps, 11·1 amperes; mean energy in ordinary lamp, 493·5 watts; mean energy of new lamp, 459·5 watts; mean ratio of the light given by the new lamp to the light given by the old lamp, 1·88. Thus, in these experiments, while consuming somewhat less energy, the new lamp gave nearly double as much light as the old lamp. There is, therefore, in an arc of this size a substantial advantage from the use of the invention. J. HOPKINSON.

5 Victoria Street, January 31, 1890.

Among the great advantages of this discovery we may mention increased steadiness, and, instead of the bluish tint always present in the ordinary arc, a fine rich yellowish-white color, very agreeable to the human eye, is produced, being almost exactly the same as sunlight, and having an enormously increased power of penetrating fog, so important for lighthouse purposes, and for use in the military and naval electric light projectors; the actual amount of light, as reported by Dr. Hopkinson, being nearly double that of the old arc light, and more than double, if we allow for the difference in energy taken by the two lamps tested against each other. The item of expense in applying the new system is so small that it may be neglected altogether, and very little or no alteration of the present arc lamps is required. The simplicity and cheapness of manufacture is, in fact, so great that it is probable not more than 20 per cent or 30 per cent in total cost need be added to the present cost of the carbons against the diminution of the general cost.

It may well be asked how these results are attained. Up to this moment there is, perhaps, no sufficient explanation; but it is highly probable that the exceedingly fine particles introduced into the arc, and impinging against the upper carbon by the ascent of the hydrocarbon vapor, are acted upon with great advantage by the electrical energy, whereas the harder particles of the carbons have to be taken from their state of cohesion, greatly reduced in size, and even then only a small percentage are found suitable for the higher incandescence (from which most of the light is derived), the grosser particles falling in dust, found after the lamp has gone out; while portions more refractory are discharged at all angles, and sometimes with considerable force. For instance, such particles have been found embedded in the surface of massive glass lenses placed some 4 or 5 inches distant from the arc flame in a horizontal direction. The work done in heating a refractory and unsuitable body for the production of light must evidently be attended by considerable loss of energy. On the other hand, the hydrocarbon vapor is (by means of the waste heat of the carbon, at a point not far from its lower end) obtained from the absorbent wick, from which it ascends, being lighter than the surrounding air, and after being raised to an intense heat as it passes upward, and having enormously expanded, it passes into the arc.

The quantity of vapor required is astonishingly small; that which can be produced from a drop of oil lasting, with ordinary carbons, nearly a minute. It is, however, not necessary to employ oil, but almost any substance or semi-liquid which, on being heated, gives off the vapor will answer well. For example, vaseline inclosed in a small capsule of the same size as the rod of carbon, and not more than about one-half inch long, will hold sufficient for the burning of the carbon down to the usual length at which it is generally taken out and thrown away. It is probable that the minute quantity of vapor required is acted upon freely, and that in its turn the incandescent gas or particles of vapor assist largely in effecting the separation of the particles of the carbon electrodes; for the consumption of carbon is increased by about one-seventh part. The light is said to be far more agreeable to the eye, and of much greater steadiness; while as to economy, arc lighting with this improvement, it is contended, is equal to gas at about 1s. per 1,000 cubic feet. With reference to search lights, it is evident that by adopting the invention the illumining power, and generally the actual value of these appliances, will be doubled, which may be an important factor in some not very distant naval action. These lights would also be found much better able to pierce the fog and haze so often found on the surface of the sea, and most important in finding coast lines and "rocks ahead."

Cold and Damp Houses.

A large proportion of the colds and ailments of the respiratory organs suffered during this season of the year are attributable to the want of proper measures being taken by builders in laying foundations and in executing the basements of our houses. Hundreds of the houses let in the suburban districts of London are built upon clay and marshy ground, often of "made earth" and rubbish. The present by-laws as to foundations and building sites have been in operation only a few years; but previous to that time houses were built upon decaying matter deposited by dust contractors, the foundations of walls were laid on the damp soil without concrete or proper courses to prevent the rising of damp in them, and damp earth was allowed to extend above the basement floor level. By the legislation of recent years, these matters have been more looked after by the district surveyor. We may point now to a few of the causes which contribute to cold and uncomfortable houses. First and foremost is the imperfect arrest of dampness from the soil. The only way of securing a healthful house is to cut it off as much as possible from the soil on which it stands. Ideally, one may imagine a house standing on stilts or piers, having a free current of air below, and a stair up to the floor; but this would be unattainable under existing arrangements. The next best thing is to obtain a well ventilated cellar, or, what is almost as good, a sufficient air space between the ground and the floor, this space being well ventilated by bricks, and the ground covered with asphalt or concrete. Neither of these essentials is found. There is an air space below the floor; but it is generally a rough and unleveled surface of rubbish, with the air bricks so scantily introduced, and they often clogged up by earth or dirt, that the air is in a state of stagnation, and the emanations from the soil are sucked up into the house by the warmth and fires. Another danger is added if a disused cesspool or a drain is beneath the house, and who knows how many of our houses are built over these receptacles of a past civilization? The many houses and tenements built almost level with the ground are particularly open to suspicion. A fast decaying floor or a mildewed appearance of dampness, or a musty smell under oilcloth or linoleum in the hall or passage will reveal the evil. On examination it is found, on taking the rotten boards up, that the joists are close to or rest on the ground, that the bond timber is rotten, or no damp proof course inserted. Hundreds of small houses are found yearly in this condition of incipient decay, which often begins under the passage floor, near the staircase or back door. The only remedy is to excavate the soil, underpin the walls, and lay a damp course over soil, replacing the timber on sleeper walls of proper construction. The want of ventilation is usually found to be the cause.

Houses having half basements or parlors below the ground floor are very common in the metropolis; but these as living rooms are highly objectionable, with the exception of those which have not been excavated, and are built up from a lower natural level in the rear, in which case the lower story becomes the ground floor story of the house behind. Then it becomes necessary to form a good area or retaining wall in front to give light to the front room, or, if there is no front room, to well line the wall forming the back of the room in the rear with some bituminous compound. It is better, perhaps, to make it thick and hollow, ventilating the space. And speaking of half basements leads us to dwell on one or two points connected with dry areas. Walls built against earth ought to have an area formed along it of its whole height. On the return side of semi-detached houses the side wall must be built often without any area, and in this case the space next the wall for a foot or more should be filled in with broken stone, and a drain be placed at bottom just below the level of footing. An asphalt coat on the outer face of wall returning in the joint at the floor level should invariably be put. A more efficient protection would be an area covered over next the outer wall, called a "French intercepting drain," or a concealed area. Sometimes an impervious tile facing has been placed against the outer face of a wall so built; but of all these plans the open ventilated area is the best. We have here referred chiefly to foundation and basement measures; but the dry wall and the well protected roof are other necessaries of warm and healthful dwelling houses.—*The Building News.*

Lack of Symmetry in the Eyes.

When the average man or woman comes to be fitted with the first pair of glasses, some curious discoveries are made. Seven out of ten have stronger sight in one eye than the other. In two cases out of five, one eye is out of line. Nearly one-half the people are color blind to some extent, and only one pair of eyes out of every fifteen are all right in all respects.

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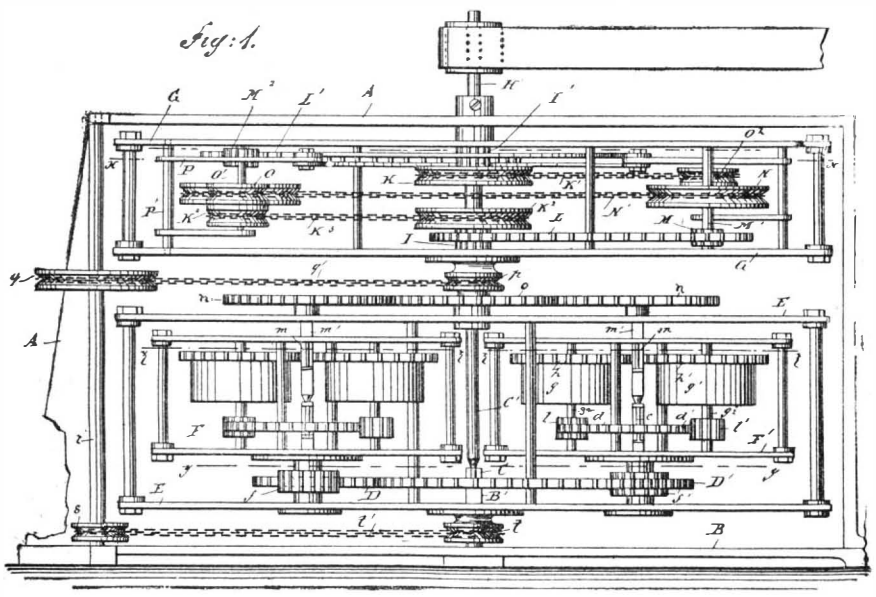
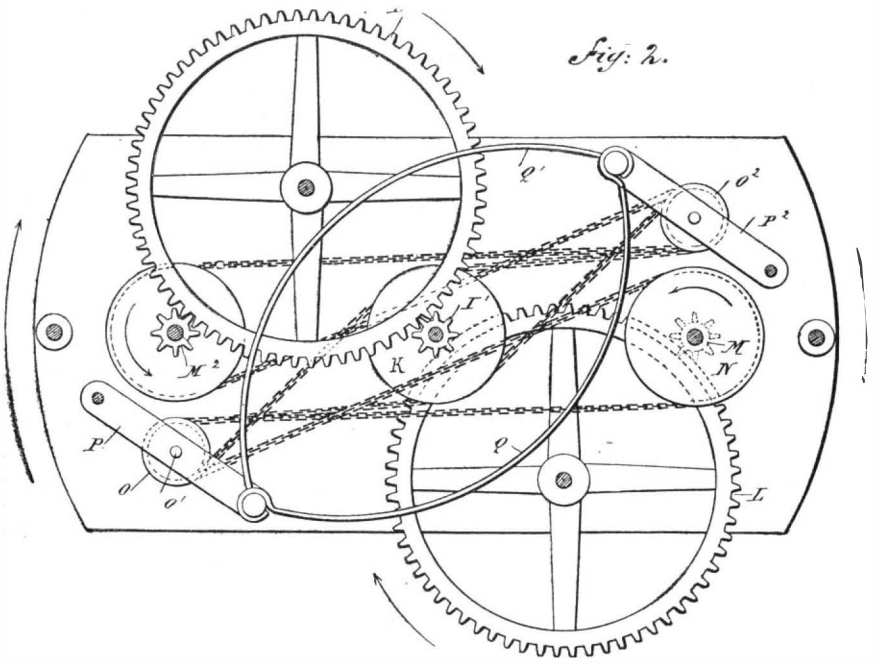
AN IMPROVED SPRING MOTOR.

The accompanying illustrations show a side elevation and sectional plan view of a spring motor patented by Mr. J. G. Ernst Reichard, of Borna, near Leipsic, Saxony, Germany. On the bed plate is a vertical spindle carrying a fixed pinion, C, into which mesh gear wheels, D and D', mounted in a frame, E, turning on the fixed





REICHARD'S SPRING MOTOR.

spindle, B'. Into these gear wheels mesh pinions on the frames, F and F', turning in the frame, E. On the latter frame is a pulley rotating loosely on the shaft, B', and connected by a chain with a pulley on a shaft turning in suitable bearings on the main frame. On the latter shaft is a pulley connected by a chain, q, with a pulley on the shaft, C', the latter pulley carrying a supplemental frame, G. The frames, F and F', carry spring barrels, g and g', and the shaft, H, turns loosely in the frame, G, the shaft, H, transmitting the power of the motor to other machinery to be driven. When the springs in the barrels, g and g', are wound up they exert a tension at both ends. When the frame, G, rotates, motion is imparted to the several devices in the frame, so that a rotary motion is finally imparted to the main driving shaft, H. The springs, Q and Q', assist in re-enforcing the power derived by the rotation of the frame, G.

DURRIN & SHELDON'S TYPE-WRITER ATTACHMENT.

The Electrical Transmission of Power.

A remarkable electrical transmission plant has recently been put down in the State of Nevada, in the world famous Comstock Lode, and the almost equally famous Sutro Tunnel. At the Nevada Mill there is a 10 ft. Pelton water wheel, which receives water through a pipe line delivering water from the side of Mount Davidson under a head of 460 ft., giving 200 horse power. Here the water is again caught up, delivered into two heavy iron pipes and conducted down the vertical shaft and incline of the Chollar Mine to the Sutro Tunnel level, where it is again delivered to six Pelton water wheels, this time running under a head of 1,680 ft. Each of the six wheels is but 40 in. in diameter, weighing 225 pounds; but with a jet of water less than $\frac{5}{8}$ in. in diameter, they develop 125 horse power each. On the same shafts, which revolve 900 times a minute, are coupled six Brush dynamos, which generate the current for the electric motors that drive the stamps in the mill above ground. The result is that, where it formerly took 312 miners' inches of water to operate 35 stamps, but 72 inches are now required to run 60 stamps. This is the greatest head of water ever used by any wheel, and by itself constitutes an era in hydraulic engineering. A solid bar of iron thrown forcibly against this tremendous jet rebounds as though it had struck against a solid body instead of a mobile fluid. The speed of this jet, where it impinges against the buckets of the wheel, is two miles a minute—176 ft. a second. The wheels only weigh 1·8 pounds per electric horse power when working with the maximum head, figures which, *Engineering* says, are only surpassed by the Brotherhood engines used for driving torpedoes, and possibly by the Parsons steam turbine. At the Terni steel works, in Italy, there is a Girard turbine using water under a head of 1,000 ft., which we believe is the greatest head used in Europe.

AN IMPROVED TYPE-WRITER.

An attachment for type-writers, by means of which the shifting of the characters and the spacing may be effected without using the hands therefor, is shown in the accompanying illustration, and has been patented by Messrs. Reuben Durrin and Rosecrans Sheldon, of Streator, Ill. To the under side of the stand are hinged two bell crank spring-pressed levers, the horizontal arm of one lever being connected to the capital-shifting key by a rod, shown in a dotted line, while the horizontal arm of the other lever is connected with the spacing key by a rod, having at its lower end a loop entered by a pin carried by the lever, so that as the lever is thrown by the knee, the spacing key will be drawn down, but will return to its normal position after the spacing has been effected. The figure-shifting key is connected with a horizontal lever beneath the table. To throw the capital characters into printing position the operator presses a knee against one side lever, pressing the opposite side lever when it is desired to space, while to throw the figures into printing position the central lever is pressed by the knee, the latter lever being adjustable to any desired height.

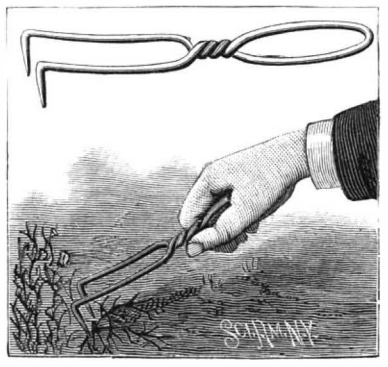
THE Charter Gas Engine Company, of Sterling, Ill., issue a compact little pamphlet descriptive of their engine, and with testimonials of those using it, which is well worth the attention of all who require power for any purpose. The Charter engine uses naphtha and gasoline direct, thereby saving the expense of manipulation to make gas, and conserving all the energy of the fuel. It is claimed that the engine can be run at an expense of one cent per indicated horse power per hour, at the average price of gasoline. It is a very simple and compact engine, not likely to get out of order.

Perpetual Carnations.

John Thorpe, than whom there is no better authority, says, in *Garden and Forest*, that carnations to flower in the open ground this summer should be planted early in this latitude—any time after the 10th of April if they have been growing in a cool place. Carnations are better without fire heat at this season. It is important that the soil in which they are to be planted be rich in potash, and a liberal dressing of wood ashes is, perhaps, the best means of supplying this element. If the plants are ordinary spring-struck cuttings, they should be planted about a foot apart each way; plants that have been wintered over in five inch pots require more room, and, of course, give more flowers; yet, if the same amount of money is expended in small plants, the additional number should produce the same amount of bloom. The varieties of carnations are so numerous, and so large a proportion of them are excellent, that it is hardly worth while to name a select list. Unfortunately there are but very few thoroughly hardy varieties of the class known as border carnations. Seedling plants will go through the first winter safely, as a rule; afterward, however, whether the plants are layered or stock is obtained by cuttings, the losses are heavy and the plants badly crippled. Unfortunately, we cannot grow the clove carnation here as they are grown in England, and where they are among the most satisfactory of garden plants.

AN IMPROVED WEEDER.

The engraving herewith shows a very cheap and convenient tool, which has been patented by Mr. Albert W. Stiles, of Rock Creek, Ohio. This implement is made from a single piece of wire rod having an ovate handle formed by bending the wire, when the strands are twisted to make a shank and the two limbs are made



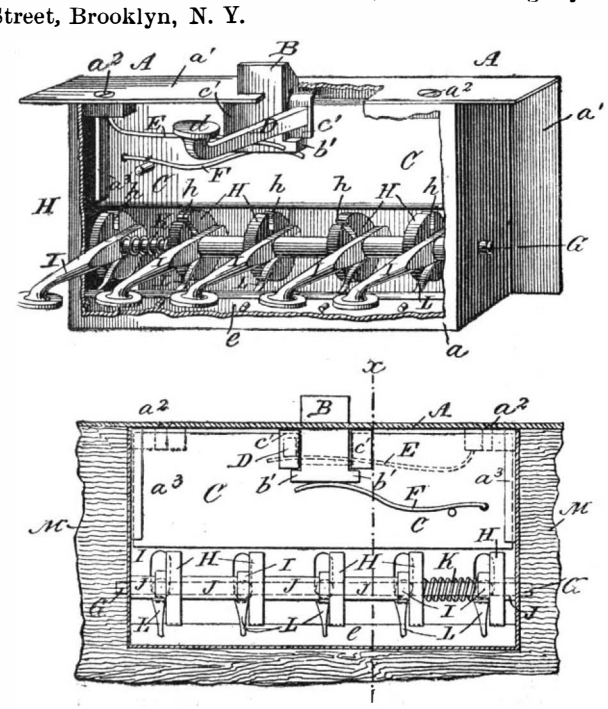
STILES' GARDEN TOOL.

with hook-shaped ends, thus constituting a simple and inexpensive tool for removing weeds, etc.

AN IMPROVED PERMUTATION LOCK.

The lock shown in the accompanying illustration is designed more especially for money drawers, and to be operated only by authorized persons knowing the proper order in which the levers or parts must be worked to allow withdrawal of the bolt. It has been patented by Mr. Alfred C. Lawrence, Toronto, Ontario, Canada. In this lock the latch bolt, B, has a slot on which the bolt plate, C, loosely fits, the bolt also having an independent vertical movement on the plate. In thus making the bolt independently movable on the bolt plate the drawer may be closed without working the permutation disks after the levers, I, have been released. When the drawer is open and the arm, D, is up, the levers, I, being down, the drawer may be closed in the ordinary way, but when strongly pushed home the spring, F, lifts the bolt behind the catch plate and holds the drawer securely locked.

For further information in reference to this invention address Mr. James M. Shannon, No. 50 Willoughby Street, Brooklyn, N. Y.



LAWRENCE'S LOCK.

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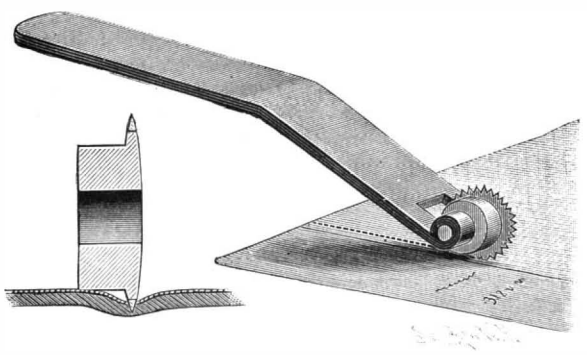
AN IMPROVED PERFORATING WHEEL.

A wheel for perforating paper, as checks, drafts, etc., to be separated from duplicates or stubs, is shown herewith and has been patented by Messrs. Joseph Jensik and Charles Stoll, of Chicago, Ill. This wheel is mainly designed for use in paper-ruling machines, the small figure being a transverse section of the wheel in operation on the paper. The wheel is carried by a holder, to be attached to a clamp, as ruling pens are

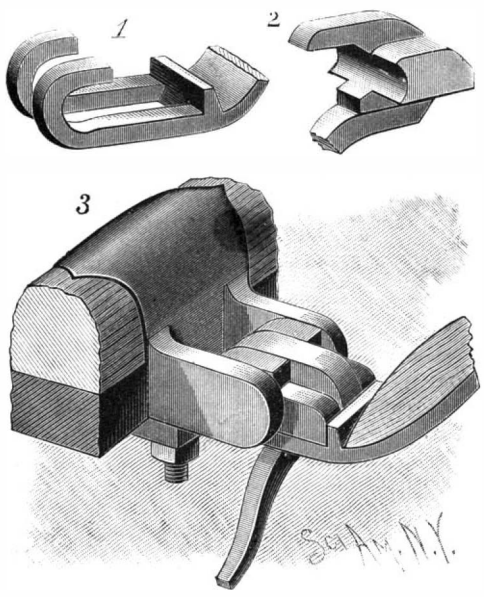


JENSIK & STOLL'S PERFORATING WHEEL.

secured, and is designed to be very serviceable in small binderies, where it would not be profitable to have a separate perforating machine.

AN IMPROVED THILL COUPLING.

The coupling shown in the engraving herewith has been patented by Mr. Martin L. Schoch, of New Berlin, Pa. Fig. 1 represents a portion of the thill iron, with knuckle and hooks thereon, Fig. 2 partly showing the key with locking lever, while Fig. 3 represents the whole device in perspective. Attached to the axle clip in the usual way are two forwardly projecting lugs or ears, with a cross bolt adapted to be engaged by hooks in the slotted end of a thill iron,

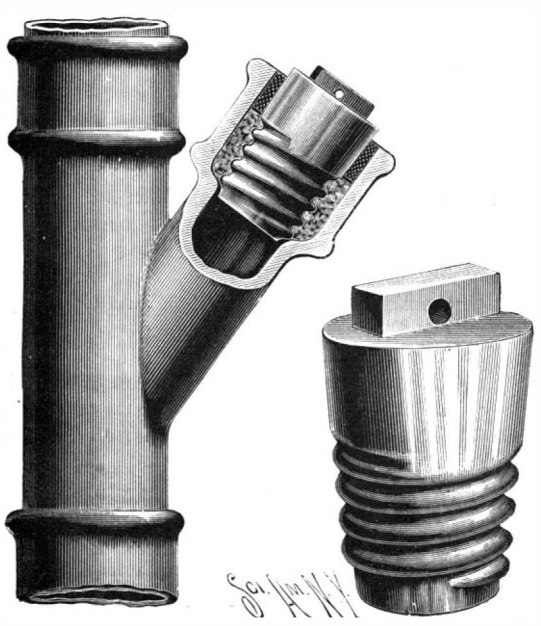


SCHOCH'S THILL COUPLING.

there being a raised knuckle near the end of the thill and a peculiarly formed key adapted to enter the slot of the thill iron, to engage its knuckle and overlap the cross bolt, thus holding the parts together, the key having a depending lever by which the parts may be locked in position.

THE NONPAREIL PIPE PLUG.

Here is something that will be appreciated by plumbers at the first glance. It is a calked plug for soil pipes and other pipes, that can be quickly put in and quickly removed, without the necessity of chipping out the packing with chisel, and danger of injury to pipes. It consists substantially in providing the ordinary plug with a head and with coarse screw thread, as shown in our engraving. The plug is applied as usual, an oakum packing being first put in, then the lead balking. This makes a perfectly strong and tight seal. To remove it is only necessary to apply a wrench and unscrew the plug. When the plug is removed and the fixtures put in, there is just sufficient lead and oakum present to recalk the joint. Among other advantages of this plug are the following: It is inexpensive. It is perfectly tight. It is durable. It is easily removed. If used in new buildings and placed in position as the plumbing work advances, these plugs will preclude the possibility of obstructions of any kind getting into the pipe, which often happens. If any fixture should be abandoned, the outlet furnished with this plug is sure to be properly closed. This plug has been tested up to between 80 and 90 pounds pressure per square inch. Several hundreds of them were used in the great *World* building, New York, where there are 25 lines of soil pipes, some of them 200 feet in length. The use of these plugs saved a great amount of time, and stood the inspection pressure with complete success. Further information may be had by addressing the J. L. Mott Iron Works, 88 Beekman Street, New York.



THE NONPAREIL PIPE PLUG.

CARTER'S DITCHING AND EXCAVATING MACHINE.

The accompanying illustration represents a ditching and excavating machine designed to dig from two to four hundred rods of ditch 3 feet in depth, 14 inches wide on top and 10 inches in bottom. It is the invention of Mr. Henry Carter, of Albion, N. Y. The machine consists of an elevating wheel with buckets, which chop into the earth in the bottom of the drain, and thus prevent the elevating wheel from slipping in tough, sticky clay, at the same time giving it power to raise the earth up through a flexible back, which yields to allow a stone or other obstruction to pass freely up through the throat to the discharge chute. These buckets are so arranged that a cam roller raises them as they approach the discharge chute to pass over a scraper, which clears the elevating wheel of all the earth, forcing it down the chute to either side of the ditch. After passing this chute another roller adjusts the buckets to their original position, where they are held by a brake attached to each journal, which is provided with a spring and set nuts which will adjust them to any desired tension. The plow is so arranged that the operator can, with a hand wheel, raise or lower it to take any desired depth of cut. The tilt on the front of the machine allows the plow to be raised or lowered ten inches without changing the position of the elevating wheel, thereby permitting the operator to set the plow to any desired depth of cut for either hard or soft soil. The plow is so attached that it will, when coming in contact with a large stone or rock, rise up and pass over without danger of breaking the machine; while at the same time, if it passes under a small stone, which is too large to get up through the throat, it automatically yields back, making the throat twice the original size, allowing the stone to pass freely through to the discharge chute.

CARTER'S DITCHING AND EXCAVATING MACHINE.

For Getting Rid of Mosquitoes.

Robert H. Lamborn has placed in the hands of the managers of the American Museum of Natural History, New York, the sum of $200, to be paid in three prizes of $150, $30, and $20, for the three best essays on the destruction of mosquitoes and flies by other insects. It is suggested that the dragon fly is an active, voracious, and harmless "mosquito hawk," and that it might, if artificially multiplied, diminish the numbers of the smaller insects. A practical plan is called for in the breeding of the dragon fly or other such destroyer in large numbers, and its use in the larva, pupa, or perfect state, for the destruction of mosquitoes and flies in houses, cities, and neighborhoods.

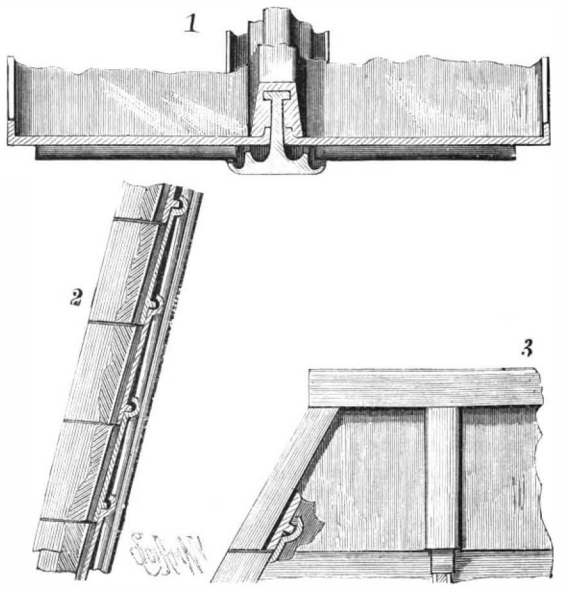
Preservation of Lard.

James L. Demoville, Ph.G., finds the alum process for purifying lard all that can be desired. The lard is melted, a little powdered alum being stirred in; then strained, cooled, and upon an inclined slab rubbed briskly with a muller, while a stream of water is allowed to trickle over it.

For preserving the lard, experiments were made besides with benzoin, with balm of Gilead buds, storax, salicylic acid, turpentine, and tolu. The best results were obtained by using one per cent of balsam of tolu; the lard was white, kept well, and had its peculiar odor well masked by the slight but pleasant odor of the balsam.

AN IMPROVED SKYLIGHT.

The accompanying illustration represents a glazed structure designed to entirely prevent leakage, the bars and lights being secured together without bolts



CAMPBELL'S SKYLIGHT.

and nuts or similar fastenings. This is a patented invention of Mr. Neil Campbell, of No. 231 East Ninety-sixth Street, New York City. Fig. 1 shows a transverse section through a supporting bar and two lights, Figs. 2 and 3 showing roof sections. In this construction the light or glass is formed with a gutter on its upper edge and a rib on its under side to serve as a stop or rest for the edge of the adjacent light, this rib projecting into an adjacent gutter, while flanges on its side engage grooves, forming a lock joint. In this way seams are avoided likely to occasion leakage and breaking of the glass.

Phosphorescence.

A French naturalist, M. Giard, has just made known the results of some experiments he has been making with *Talitrus* and other crustaceæ. On microscopically examing a brightly phosphorescent specimen he found walking slowly on the beach instead of leaping, as its habit usually is, he traced the phosphorescent light to the presence of bacteria in its muscles, which were greatly altered. On inoculating other and healthy individuals of this and other species the same disease was produced among them, and M. Giard says that his laboratory was quite lit up at night with these diseased but luminous crustaceans. The inoculation was continued to the sixth generation, apparently without any attenuation of the microbic action. The disease seems to follow a regular course, and the crustaceans died in three or four days. The phosphorescence, however, always lingered a few hours after death. Crabs were inoculated in the same way.—*Science Gossip.*

PRESERVE FOR BINDING.

The publishers of the "Scientific American" would advise all subscribers to preserve their numbers for binding. One year's issue (52 numbers) contains over 800 pages of illustrations and reading matter. The practical receipts and information contained in the Notes and Queries column alone make the numbers worth preserving. Persons who have subscribed since the commencement of this year can have the back numbers sent them on signifying such wish. Their subscription will then expire with the year.

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CLIMBING THE GREAT CHIMNEY OF THE CLARK THREAD WORKS, AT HARRISON, N. J.

On the morning of Friday, March 28, the great chimney in the Clark Thread Works, Harrison, N. J., was struck by lightning. There were two discharges, one at 8 A. M., the other fifteen seconds later. The first threw down bricks from two spots; the other, more severe, attacked it in eight or nine spots more. Altogether, from fifty to seventy-five cartload of bricks fell, cattering widely in their descent, the outer surface being stripped in places to the depth of three courses of brick, or about twelve inches. The occurrence excited much alarm among the operatives. The works were at once shut down, pending an examination of the chimney for stability.

The shaft is unprovided with any ladder or other means of ascent. The original idea was that if it should become necessary to reach its top, a balloon would be sent up in the interior, carrying a line. The cast iron cap which surmounts it has an edge at the top so thin that any method which involved the use of a line reaching over this edge was rejected as unsafe, owing to the danger from chafing. This precluded the balloon method. Eventually the services of a professional chimney and steeple climber were secured, and within a week, with about three and a half days' of work, he reached the top by ladders fastened to the exterior. The method he adopted is one which is used in England and Scotland. We illustrate in the present issue the general course of his operations.

The side of the chimney opposite to that which was struck by lightning was selected as the scene of operations. This insured a sound base for the work and avoided any danger from falling bricks. A ladder was first placed against the shaft. A block of wood was inserted between the chimney and the upper end of the ladder. The block was a little longer than the ladder was wide, and held it about seven inches out. Next two straight-shanked hooks of seven eighths round steel, with wedge-shaped points, were driven into the joints between two courses of brick just outside of the sides of the ladder, and as near the block as possible. The bent ends of these projected horizontally inward and gripped the sides of the ladder. The hooks were driven in until they drew the ladder and block strongly against the brickwork.

A second ladder was now drawn up by block and tackle. The end of the fall was caught over the sixth rung or thereabout, and the fall itself was lashed to the top rung. A steel hook was driven into the chimney above the top of the ladder already fixed. To this the pulley block was fastened. The ladder was drawn up from the ground and as its top reached the chimney climber, he cut the lashing of the top rung and guided it by hand as it rose above him. When it was so far up as to lap over the lower ladder by about five feet, the lower end of the fall was secured to a hook driven into the base of the chimney and placed there for the purpose of belaying it. The ladders were now lashed together. Going up a little further, a hook was driven outside and to the right of the upper ladder, about half way up. To this it was lashed. Next, a second hook, placed with its bend vertical, was driven a couple of rungs higher up to the left and inside the ladder, so as to catch under a rung. It was lashed to this. Then climbing up still further, the upper hooks were driven so as to grasp the ladder and cross block exactly as below. All this while the tackle was kept belayed. To make the ends lie snug a cross piece of board was secured across between the lower end of one ladder and the one beneath it. The tackle was now cast off, and the operation was repeated with a third ladder. In this way the string of ladders shown in our cut quickly rose until the projecting bell was reached, when a variation in the progress became necessary. Hitherto, with the exception of the lower one, the length of the ladders had been 17, 20, and 22 feet. Twenty-four ladders had reached the end of the plain shaft. Near the top of the upper ladder two holes were drilled in the brickwork. In these expansion bolts were introduced. They consisted of a twelve inch length of gas pipe split for a few inches at the inner end. A piece of iron with expanded or pear-shaped end was introduced from the split end, and a nut was fitted near its other end, on which a thread was cut. Finally it was drawn down a little and bent into a ring or eye. When this was put into the hole, and the nut screwed up, the pear-shaped end was drawn into the pipe, opening the split end against the sides of the hole and dovetailing it firmly in place. Next, a third hole was drilled as high up as possible, and in the prolongation of the line of the ladders.

A thirty-foot ladder was now drawn up until its end projected two feet above the lower edge of the iron cap. Its lower end was lashed to the lower expansion bolts. By the block and fall it was drawn in toward the upper expansion bolt until it bent into a curve with the strain, and it was then lashed fast there.

A short iron ladder, with hooks upon its upper end, was drawn up and placed upon the upper slope of the iron cap, and the work was achieved.

The operations were in charge of the firm of Smith & Phillips, slate and felt roofers, of Newark, N. J. Mr. John Phillips did the climbing, being an expert in this work and familiar with it from his experience in Scotland. He is a slight-built man of Scotch birth, and seems to treat his achievement as an ordinary affair. Our drawings give an excellent idea of his appearance. He has done one of the finest pieces of chimney climbing ever executed, and deserves great credit for bringing it to a termination without accident of any description. In performing his work he relied partly on a hook attached to a piece of rope which was fastened around his waist. The hook he caught in the rungs of the ladders, so as to leave both hands free. In going up and descending, he attached the end of the fall to this hook and had about half his weight taken by his men working the rope from the ground. It took him about ten minutes to make the complete ascent after all the ladders were in place.

An examination of the interior of the chimney, made from a boatswain's chair suspended as shown in our cut, showed that it was perfect, and the thread works were started into operation.

Six hooks of heavy steel had first been fastened over the edge of the cap, and chains attached thereto that hung down from the lower edge of the iron. Four blocks and falls were attached to these, by which a scaffold was hoisted that surrounded the chimney. The other hooks and chains were for the attachment blocks and falls for hoisting brick and mortar with which to execute the repairs. By the use of iron hooks and chains it became possible to go on with the repairs of the exterior of the chimney while the factory was in operation. The scaffold, when hoisted to the proper level, was reached by the long string of ladders. As the loose material was removed and replaced by new, the scaffold was raised or lowered as necessary.

The protection of chimneys from lightning has been the subject of recent investigation. In the SCIENTIFIC AMERICAN SUPPLEMENT of the present week, No. 746, will be found an article giving the details of the latest conclusions reached by experts on this subject. Had this chimney been properly protected by rods, it doubtless would have escaped injury.

The Highest Chimney in the United States Damaged by Lightning.

A correspondent writes as follows: At eight o'clock in the morning, March 28, 1890, the many hundreds of employes of the great establishment known as the Clark Thread Works, opposite Newark, N. J., were startled by a tremendous crash of thunder, and at the same instant beheld a ball of fire, estimated to be two feet in diameter, gliding down one side of the great chimney, throwing into the air a cloud of bricks and debris. Fifteen seconds later came a second terrific crash, caused by the fall of another stroke of lightning upon the chimney. Here is an example of lighting striking twice almost in the same spot.

The apex of the chimney is covered by a massive cap of iron of 6 tons in weight. The first stroke tore out a few bricks under the bell-shaped top of the chimney, then skipped over portions about twenty feet long and made four ugly-looking, ragged-shaped gashes in the exterior wall of the chimney, two and three bricks deep inward, two feet wide and several feet long, down the north side. Below these a serious crack, perhaps fifty feet long, was made. The second stroke tore out a few bricks on the bell portion.

As a precaution it was deemed best to shut down the mill until the interior wall could be examined, although it is believed to have sustained no injury. The chimney was also kept warm to prevent contraction. As no means had been provided at the time of erection to reach the top of the chimney in case of accident, the interesting question arose as to how this could be quickly done. After discussing the matter thoroughly, the proprietors accepted the offer of Mr. John Phillips, commonly called in Newark "Steeple Jack," to scale the outside of the chimney, a task which he successfully accomplished in three working days by means of ladders, which he placed one above the other, securing them firmly to the chimney as he went up, by means of strong steel hooks driven into the brickwork. Subsequently, by means of ropes and slings let down within the chimney, the interior walls were carefully examined and found to be uninjured.

It seems strange that in this age of electrical enlightenment the owners of this fine chimney should have neglected to protect it by ample conductors which might easily have been connected underground directly to the extensive series of underground iron pipes pertaining to the establishment. These would have afforded excellent grounding for the electrical conductors.

The Clark chimney was completed in September, 1888, and is a most graceful structure, as well as a fine example of good masonry. Its strength and stability must be considered as proved after having thus withstood the assaults of the twin lightning strokes.

The shaft is circular, and rises with a perfectly uniform batter from the bottom to the neck below the cap. Its diameter at the base is 28 feet 6 inches, and at the neck is 14 feet. This gives a batter of 7 feet 3 inches, or 2·85 inches for every ten feet. Its total height is 335 feet. Its internal diameter is 11 feet, giving one circular flue. At the summit it expands into a well-proportioned capital surmounted by a cast iron coping. The latter weighs six tons, and is composed of thirty-two sections. They are bolted together by inside flanges, so as to present a smooth exterior.

The foundation is in concrete, composed of crushed limestone 6 parts, sand 3 parts, and Portland cement 1 part. It is 40 feet square and 5 feet deep, forming a block of 8,000 cubic feet volume, and weighing about one million pounds.

On this the base was started, composed, like the shaft proper, of brick laid in cement mortar. Two qualities of brick were used. The outer portions were of the first quality North River, and the backing up was of good quality New Jersey brick.

Every twenty feet in vertical measurement an iron ring, 4 inches wide and ¾ to ½ inch thick, placed edgewise, was built into the walls, about 8 inches from the outer circle.

As it starts from the base the chimney is double. The outer wall is 5 feet 2 inches in thickness, and inside of this is a second wall 20 inches thick and spaced off about 20 inches from main wall, and, of course, concentric with it. From the interior surface of the main wall eight buttresses are carried, nearly touching this inner or main flue wall, in order to keep it in line should it sag. The interior wall, starting with the thickness described, is gradually reduced until a height of about 90 feet is reached, when it is diminished to 8 inches. At 165 feet it ceases, and the rest of the chimney is without lining; no fire bricks in the lining.

The total weight of the chimney and foundation is 5,000 tons.

Eugenol or Sodium Silico-Fluoride.

The first statement in regard to the medicinal properties of this salt was made before the British Medical Association, in September, 1887, by Mr. Wm. Thomson, F.B.F.C., F.C.S., of the Royal Institution, Manchester, England, at the conclusion of a series of experiments to determine the disinfectant properties of different substances. By these he found that the compounds of fluorine were the most powerful, and of these the sodium silico-fluoride was probably the most serviceable.

Because of these statements work was begun in the clinic room of the Philadelphia Dental College with this medicament during the session of 1888-89, hoping to find in it a substitute for hydrogen peroxide, that being objectionable on account of its changeable character and the occasional pain from its use.

The preparation of sodium silico-fluoride is very simple. A mixture of flour-spar and any siliceous substance, as sand, is heated in a retort with H_2SO_4, the resulting gas being distilled over through mercury into water, which holds it in solution, and which is then filtered to remove the free silicon which precipitates. The filtered solution is then carefully tested and the acidity neutralized by carbonate of sodium when the sodium silico-fluoride or fluosilicate of sodium precipitates. Properly prepared, this should give a perfectly neutral reaction to litmus paper.

From five to seven grains are dissolved per ounce of water.

Several experiments were made with a solution of two grains to the fluid ounce, this strength having been found both by experiment and by clinical experience to be one well suited to most purposes. The pulp chambers and canals of teeth were successfully treated with it, and proved it to be efficient as a disinfectant, even where only very slight care was given to the canal work.

One application, either by syringing or by wiping out with cotton, is sufficient, generally, to neutralize the odor of the most offensive putrescent pulp, a quality not by any means to be despised. Being inodorous, it acts not by substituting a less offensive odor, but by destroying the putrescent material by taking away its hydrogen.

Sodium silico-fluoride is, when properly used, capable of becoming one of the most useful salts in the dental pharmacopœia. As a disinfectant it has been shown to be powerful enough, even in weak solution, to markedly antagonize the germs of putrefaction; as a coagulant, to be non-escharotic; as a deodorant, strong enough to destroy the most penetrating of putrefactive odors; as a stimulant, strong enough in full solution to cause new tissue to form and yet not act as an irritant to surrounding tissue. It is practically unchangeable, the only change being that noted regarding its solubility, which is not of the slightest practical importance.

Such being the case, it would seem to be the best medicament of its class as yet known, and to be at least worthy of most careful consideration and of extended experimental utilization by the dental profession.—*Dr. H. E. Vaughan, in Dental Cosmos.*

TELEGRAPHERS have ways of communicating to each other unknown to common folks. Said one of them: "If I am sitting next to an associate in an audience room, I never speak. I simply tap out my message on the hand of my friend."

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Correspondence.

A Kite as Life-saving Apparatus.

To the Editor of the Scientific American:

Twenty years ago a Dutch carpenter, named Sluik, and living at Harlingen, Netherlands, invented a sort of kite, intended to serve as means of communication with the shore in case of shipwreck.

This kite, consisting of canvas and stretched out on a couple of laths, is held by a strong rope. At some fathoms distance from the kite is a loop to which a belt is attached and in which a man places himself when jumping into the water, and then by veering out the kite the man is carried to the shore.

Some time ago a man was experimented with, and with the best results. On Monday morning, March 10, 1890, while a strong breeze was blowing from the southwest, another experiment was performed in presence of some captains of the mercantile fleet. This time, however, a bag filled with straw and sand, and having the shape of a man, was put in the belt.

Within five minutes this object was carried from the one pier of the "new harbor," at Harlingen, to the other, a distance of 200 meters. The kite held the supposed man very well above the water.

The above was published in different newspapers of this city. G. VANDER MEULEN.

Amsterdam (Netherlands).

The Whistling Well.

To the Editor of the Scientific American:

I have read Mr. F. S. Oakes' description of the whistling well, in your issue of the 22d ult., and it seems to me that the varying pressure of the atmosphere as indicated by the barometer would account for the phenomena described.

The well diggers may have penetrated an impervious stratum into the bed of gravel, which formed a reservoir for the air, which would rush in or out of the aperture with a change of pressure of the atmosphere, until an equilibrium was established.

I have noticed a similar action in connection with a gas well of very low pressure which supplies my house with natural gas, and of which I am the only user.

I burn this gas in our cook stove and several burners for light, under a pressure of 4 to 8 inches of water, as measured by a gauge attached. With a low barometer we get a much greater flow, and less with a high barometer.

There is sometimes a difference of over an inch in the reading of the barometer, which would represent a difference in pressure of nearly half a pound to the square inch and would account for the phenomena in both cases.

If there is any other explanation of the matter, I would like to hear it. E. R. CARPENTER.

Collingwood, Ontario.

Natural Gas in Indiana.

To the Editor of the Scientific American:

Some time since I noticed an article, purporting to come from your paper, under the caption of "Natural Gas in Indiana."

In that article you say: "The big wells in the upper portion of the Indiana belt, like the 'Jumbo,' at Fairmount, in Grant County, which furnishes 11,500,000 feet daily, and which has transformed that town into a manufacturing center with a doubled population, show no appreciable diminution of the flow since they were struck, more than two years ago."

In the main, the above quotation is correct, excepting the flow. "Jumbo" was tested about one year ago by experts from the Pennsylvania gas fields, and by permission the writer was permitted to a place on the derrick. After the test was completed the figures showed a flow of, in round numbers, 14,500,000 feet every twenty-four hours. As regards the diminution of gas wells, probably the following facts would be of some interest to you, if not now, possibly in the future: The Fairmount Mining Co. drilled the Jumbo well three years ago, and shortly after it was drilled sold it, presumably to a Fort Wayne (Ind.) man. They then went one-half mile west of the Jumbo site and drilled another well, from which the town (including factories, mills, etc.) used up until last fall, when the company repurchased "Jumbo," in order to have plenty of gas for all the factories that might locate here. When the valve was opened, allowing the gas to rush into the mains, it was a self-evident fact that "Jumbo" had lost none of its mighty power. The second well has been regulated by the same weights since it has been in use, save in summer time, when more weights are used to lower the pressure, owing to the removal of extra heaters.

As I write this the Citizens' Mining Co. are drilling a well within hailing distance of the Fairmount Co.'s well No. 2, and could you hear the roar of the gas as it escapes from the casing, with the drill still at work, you would have no concern, were you interested, as to the staying qualities of Indiana's natural gas.

I have been in the gas territory two years, and there have been thirty or more wells drilled in this and immediate townships in that time. Every one of them have proved "gushers," as we call them here, *and none have ever failed.*

There are a great many things connected with the development of natural gas that have never appeared in print. These papers that pretend to tell what they know about it usually commence and wind up an article by "booming" the town that has it, and the patient seekers after plain facts are never enlightened.

Pardon me for intruding on your time, but reading your article suggested this letter. E. A. MORGAN.

Fairmount, Ind., April 5, 1890.

ECONOMY OF BELTING AND PULLEYS.

The power transmitted by a belt over flat-faced or slightly crowned pulleys can be increased (the nature and condition of the surface in contact remaining the same) by increasing the tension, the arc of contact, the width of surface of contact, or the speed of belt.

Greater tension increases the power transmitted, but impairs the durability of a belt.

There are numerous rules, and rules combined with tables, for computing the horse power transmitted by a given belt, but all of these assume a certain tension, corresponding to thickness of belt. And one of the most common rules (a single leather belt one inch wide, traveling at a speed of 1,000 feet per minute, will transmit one horse power) disregards everything but speed; as the width of belt is only one factor in determining the area of surface of contact. This rule, however, is easy to remember, and is a safe one, in ordinary cases, where the difference between the diameters of the two pulleys connected is not very great.

When one pulley is very much larger in diameter than the other, and the distance between the centers of the pulleys small, the arc of contact of small pulley will be much less than that of large one (see Fig. 1), and

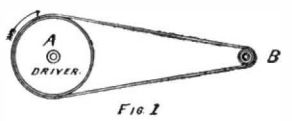

FIG 1

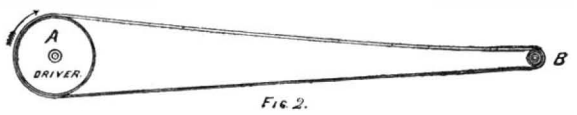

FIG 2.

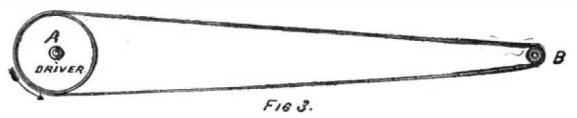

FIG 3.

unless some judgment is used after computing the width of belt by the above rule, the belt may cause trouble by slipping.

To prevent this, millwrights commonly resort to long belts (when horizontal or nearly so, and the lower side can be made the driving side) in order to increase the arc of contact.

The contact will not be increased, however, by a long belt, in case it is impossible to make the lower side the driving side (see Fig. 3).

Remember, now, I am comparing cases where the length of belt depends only upon the discretion of the person making the plans. Of course there are numerous cases where space and convenience determine, to a large degree, the length of belt used.

In the case shown in Fig. 2, it is a good plan to make the diameter of pulleys as large as can be, conveniently, and then calculate width of belt as above. Then determine the actual area, in square inches, of surface of contact on smaller pulley, and then the area, if the arc of contact were 180°. Subtract one from the other and divide this area by the length of actual arc of contact in inches. Add this quotient to width of belt computed by foregoing rule. This will give all the advantages of the long belt.

Now let us take an example: Let the pulley, A, Fig. 1, be 30 inches diameter; let the pulley, B, Fig. 1, be 6 inches diameter. Let the number of revolutions of A be 200 per minute. Let the lower side of belt be the driving side. Now it is desired to connect these two pulleys by a flat, open leather belt to transmit 9½ horse power. According to rule, a belt 6 inches wide will be required. In order to preclude any possibility of slipping, under ordinary circumstances, suppose we attempt to make arc of contact on smaller pulley 180°. By making the distance between centers 15 feet we can obtain this, approximately.

Let us see what this will cost, according to average list prices:

One pulley 30 in. by 6 in.	$11 10
One pulley 6 in. by 6 in.	2 00
34¾ ft. 6 in. belt, at 76c.	26 41
	$39 51

Now suppose we place the centers 6 feet apart. The arc of contact on small pulley will then be only about 157°; but we will make pulleys and belting one inch wider. We will then get a little more surface of contact on the small pulley than with the longer and narrower belt, and the cost according to list prices will be as follows:

One pulley 30 in. by 7 in.	$12 20
One pulley 6 in. by 7 in.	2 40
17 ft. 7 in. belting, at 90c.	15 30
	$29 90

Compare the two costs.

When renewal is necessary, it is the belt that has to be renewed. Notice the difference in cost of renewing the two belts. In actual practice, however, net prices should be used in comparing two cases, and then, of course, the actual difference in dollars and cents would not be so great. Another advantage of the short belt is that it will run much more steadily than the long one, especially at high speed and when overcoming a fluctuating resistance.

The above example may not be, in all respects, a fair one, but it is given as an illustration and a basis for thought. W. E. PARSONS, M.E.

332 Clinton St., Brooklyn.

The Sugar Maple.

The sugar maple is one of the finest of the deciduous leaved trees of North America. It is by far the noblest of the American maples, although the silver maple develops occasionally a greater trunk girth, and it is perhaps the noblest of all the maples, although the sycamore maple of Europe in the mountain valleys of the Tyrol is, when at its best, a tree second to none of its class in spread of branches and dignity of port. But the European maple lacks the lightness and brightness of foliage and the gracefulness of inflorescence peculiar to the sugar maple, while it assumes in autumn none of the brilliant colors which our American tree takes on at that season of the year and which make it then the most conspicuous feature of the landscape wherever it abounds.

The elm, to many people, is the characteristic tree of New England, because, perhaps, more than other trees, it was selected by the early settlers to stand sentinel over their homesteads; but the sugar maple is hardly less characteristic of New England, and of all the Northern States, where it is almost everywhere a very common tree, growing on hillsides and in valleys, and of late years so generally planted by the roadside that it is now more often seen than the elm, which is a more fastidious tree than the maple about its nourishment, more easily affected by drought, and a far more inviting prey to noxious insects.

The sugar maple economically is one of the most valuable American trees. The wood it produces is heavy and hard, close-grained, tough and strong. It has a surface which can be highly polished, so that it is an excellent and much esteemed furniture wood, especially those peculiar forms with twisted and contorted grain known as bird's-eye maple. It is from the wood of this tree that American shoe lasts are made in preference to that of any other, and it is used in the manufacture of hundreds of other objects, great and small, from the keel of a boat to a shoe peg. The New Englander who wants to burn better fuel than that afforded by the sugar maple must use hickory. The Indians knew the value of the sap of this tree, and soon taught Europeans how to convert it into sugar. The production of maple sugar was once a far more important industry comparatively than it is now, although the crop is steadily increasing in bulk and in money value.

The sugar maple has one characteristic which very few American trees, except some of the oaks, share with it to the same degree, and one which, when American forests are managed with the view of getting from them all they can be made to produce, will make it one of the trees most generally employed in the operations of scientific silviculture. It has the capacity to germinate and grow to a considerable size under the more or less dense shade of other trees. Young sugar maples form sometimes in the northern counties of this State, in northern Michigan and other parts of the country where this tree is common, the larger part of the undergrowth which has sprung up in the deciduous forests. These self-sown plants, in spite of the shade which, of course, checks their growth, grow with a good deal of vigor and reach a considerable height. The beech in Europe possesses the same power of growing for many years under and among other trees, and it is for this reason that the beech is one of the most valuable subjects in all European deciduous forest operations looking to natural forest succession—the prime motive of modern scientific forestry. The sugar maple is a far more valuable tree in the material which it produces than the European beech, and American foresters, when we have them, will have good cause for congratulating themselves in the possession of a subject so valuable and so easily managed.—*Garden and Forest.*

KEROSENE as a therapeutic agent is highly spoken of by Dr. H. A. Gross in the *Medical World.* It cures almost all pains, from toothache to gout and rheumatism. It is deodorized in this manner: Take of coal oil, 1 pint; nitric acid, 1 ounce. Mix. Let stand for a week and pour off the supernatant oil. It does not in the least smell like coal oil.

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THE SCIENTIFIC USE OF THE PHONOGRAPH.

BY GEO. M. HOPKINS.

II.—THE PHONOGRAPH AS A CHRONOGRAPH.

In the first article of this series, it was stated that the utility of the phonograph as a scientific instrument was to a great extent due to the perfection of the motor by which the record cylinder is revolved.

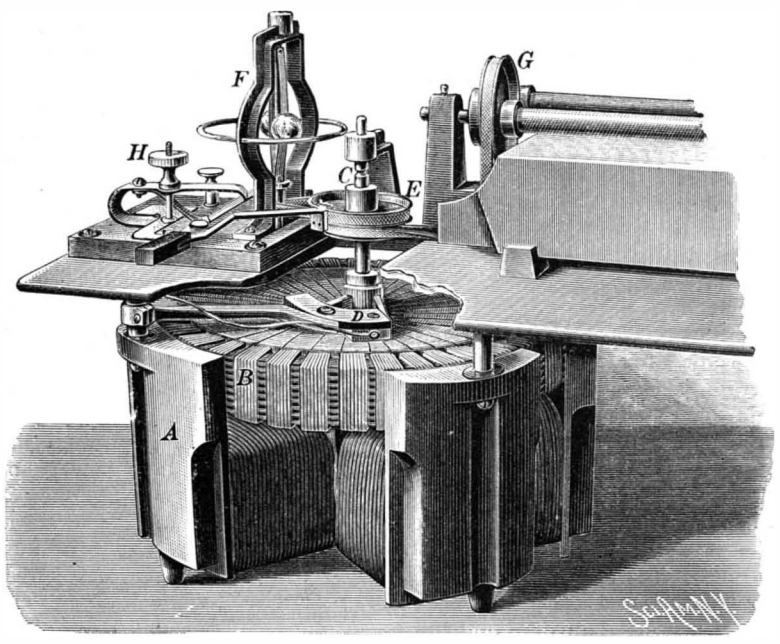

Fig. 1.—PHONOGRAPH MOTOR.

Among the different motors applied to the phonograph, the water motor and the electric motor seem preferable for scientific use.

The electric motor is represented in Fig. 1, removed from the case, a part of the plate by which it is supported being broken away to show the commutator. The field magnet, A, is formed with four polar extremities alternating as to polarity, and the armature consists of a ring, B, of the Pacinotti type, with a laminated core. The armature shaft is journaled at the bottom in a step formed in the yoke of the field magnet, and at the top on a point, C, supported by an arm projecting upward from the base plate of the instrument. The ring and the commutator are divided into twenty-four sections, the connections of which are arranged to produce four poles in the armature. The commutator brushes are held 90° apart by a curved vulcanite bar, D, supported by an adjustable arm.

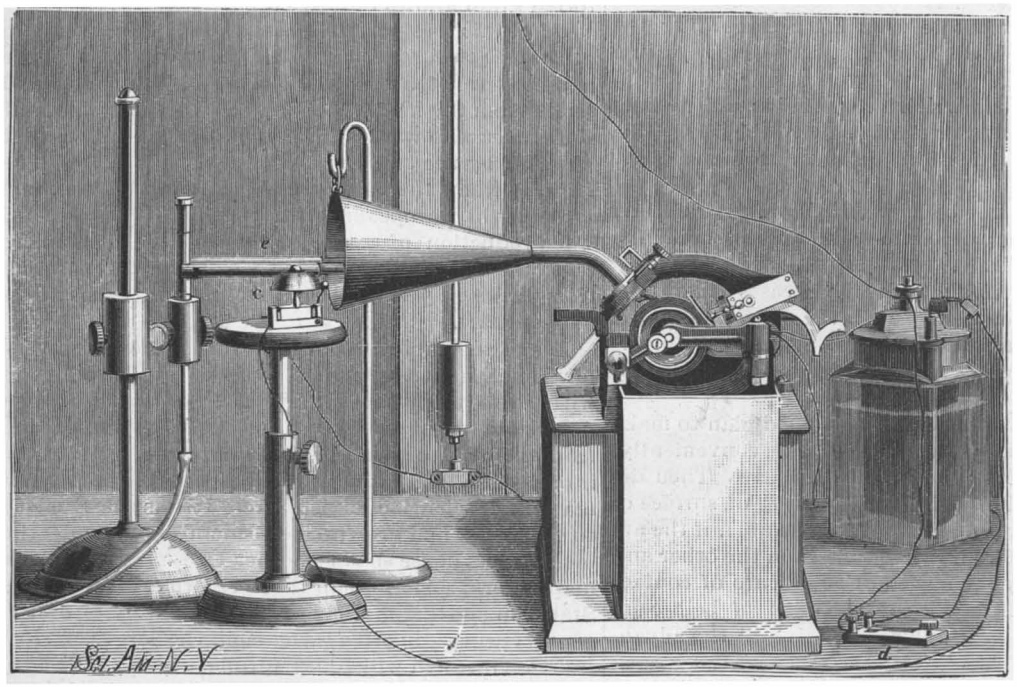

Fig. 3.—THE PHONOGRAPH AS A CHRONOGRAPH.

The motor is shunt-wound, and adapted to a two-ampere current having a pressure of two volts. It may be operated by a primary or a secondary battery; the latter is preferred for use in places affording facilities for recharging, although the primary battery furnished with the instrument is easily mounted, and yields sufficient current for about thirty hours' use with one charge.

The armature shaft is provided with a pulley, E, which drives the governor, F, and with a small pulley arranged below the pulley, E, and connected with the pulley, G, on the horizontal phonograph shaft by means of a belt whose direction is changed by two guide pulleys.

The governor is shown on an enlarged scale in Fig. 2. It is remarkable both for its simplicity and the accuracy with which it controls the speed of the motor. On the wooden base is mounted the vertical frame of the governor, in which is journaled a spindle, having near its lower extremity a pulley for receiving the belt from the pulley, E, on the motor shaft. To the upper part, and on opposite sides of the spindle, are secured two springs which extend downward. Their lower ends are secured to the flanged sleeve, *a*. To the iron frame of the governor is secured a brush, *b*, which bears continually on the sleeve, *a*. The regulating device, H, consists of a curved spring supporting the brush, *c*. Above this brush is arranged a spring arm which is made to bear upon and change the position of the brush, *c*, by turning the milled nut, *d*.

When the flange on the sleeve, *a*, touches the brush, *c*, the entire current of the battery flows unimpeded through the motor, but when the speed of the governor increases in the slightest degree, the balls are thrown outward by centrifugal force, thus bowing the springs outwardly and lifting the flanged sleeve, *a*, from the brush, *c*, causing the current to flow through a small resistance arranged underneath the base of the governor, thus diminishing the current, consequently preventing any increase of speed in the motor. Usually this sensitive governor keeps up an incessant shifting of the current, giving the armature a succession of little impulses whose aggregate and average effect is to maintain an almost absolute rotation of the governor and phonograph cylinder connected therewith.

With a motor having a governor of this character it is a matter of little consequence whether the battery used is constant, provided it has a surplus of power. To utilize the phonograph for the purpose of measuring different intervals of time, it is not only necessary to provide means for controlling the velocity of the record cylinder, but also to have a ready means of standardizing the phonograph, and checking its motion at every revolution, or at least frequently, and means for producing impressions at minute intervals for comparison with the records to be measured.

All these results are secured by the apparatus figured in Figs. 3, 4, and 5. Fig. 3 shows the general arrangement of the phonograph, and Fig. 4 is a plan view, showing the circuit closer of the phonographic cylinder. In the background of Fig. 3 is shown a pendulum beating seconds, and provided at the bottom with a mercurial contact for closing the circuit every time the pendulum swings. The phonograph cylinder is surrounded by a vulcanite ring, *a*, at its larger end, which carries a metallic bar arranged parallel with the axis of the cylinder. Two contact springs, *b*, *b'*, arranged to press upon the ring, *a*, are secured to the phonograph frame, but insulated therefrom. These springs are in parallel circuit with the pendulum, and in the conductor leading from the pendulum and the springs to the zinc pole of the battery is inserted a bell, *c*. A key, *d*, is included in a branch circuit parallel with the circuits of the pendulum and the springs, so that the circuit may be closed upon the bell by the pendulum, the circuit closing springs on the phonographic cylinder, or the key, and these may be made to act simultaneously or at different times. As the phonograph cylinder revolves ordinarily at the rate of two revolutions per second, thus closing the circuit of the bell twice each second, and as the pendulum closes the circuit once each second, it is necessary to cause these two contacts to produce but a single stroke upon the bell. If, at every alternate revolution of the phonograph cylinder, the circuit is not closed simultaneously by the springs, *b*, *b'*, and the pendulum, and the phonograph cylinder falls behind or gains upon the pendulum, it will be indicated by a double stroke of the bell. Perfect synchronism can be secured by regulating the phonograph governor.

Between the bell, *c*, and the diaphragm cell of the phonograph is suspended a funnel. To allow the arm of the phonograph to move freely, it is connected with the phonograph cell by a flexible tube. In front of the funnel, and at the side of the bell, *c*, is arranged a pair of whistles tuned so as to give beats 10, 50, or 100 to the second, so that while the bell records the half second, the beats of the whistle will make impressions upon the cylinder representing tenths, fiftieths or hundredths of a second. To prevent a prolonged sound from the bell, it is damped by stretching over it a rubber band.

Personal equation is determined by means of a key which closes the circuit on the bell independently of the phonograph or pendulum, and any of the various known methods of determining personal equation may be adapted to the phonograph. By employing visible signals, the visual perception may be tested. In a

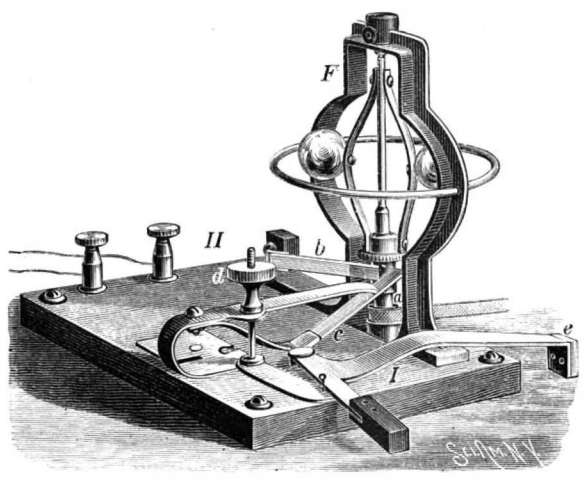

Fig. 2.—PHONOGRAPH GOVERNOR.

similar way, by means of audible signals, the activity of the auditory apparatus may be ascertained. By suitable appliances the sense of touch can also be tested. Other measurements may be made by means of a bell or other equivalent device detached from the phonograph and connected with the apparatus by which the circuit is controlled, as for example the grating used in testing the velocity of a bullet.

It is obvious that for very high speeds, as in the case of a bullet, it is necessary to have two different magnets for making the record, one for the start and the other for the stop, so that if a bell were used there would be two magnets, two armatures, and two bell hammers. It is obvious that most, if not all, of the measurements possible with the ordinary chronograph may be carried on in connection with the phonograph. The record can be easily read so as to interpret the measurement, by turning the phonograph cylinder very slowly. In case of very high velocities, it is of course necessary to run the phonograph as rapidly as possible, and to provide a pair of whistles of higher pitch, so that the sounds will be perceptible when the speed of the phonograph cylinder is reduced for the purpose of reading the record.

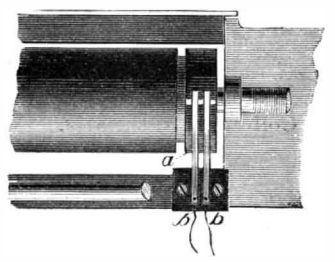

Fig. 4.—CIRCUIT CLOSER.

How to Fix Magnetic Curves.

In M. Korobow's process a plate of glass is warmed and covered with paraffin in a thin layer. The image is formed with iron filings, in the usual manner, on the cooled paraffin. To fix the curves, the plate of glass is again warmed. Finally, the surface of the paraffin is covered with white paint, so that the curves appear black on a white ground. Very well defined figures may thus be obtained. A similar and simpler process consists in covering one surface of stiff white paper with a layer of paraffin, by warming, spreading the filings over the cooled surface, and fixing them with heat.

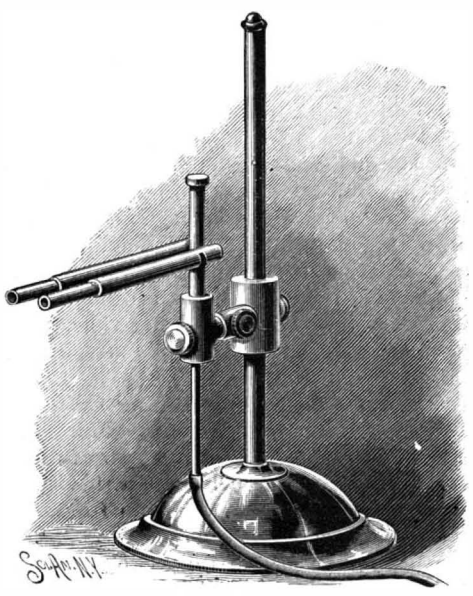

Fig. 5.—WHISTLES FOR PRODUCING BEATS.

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AN IMPROVED MITERING MACHINE.

The mitering machine shown in the accompanying illustration has been patented by Mr. William Murphy, of Union Street, St. John, New Brunswick, Canada. The frame has vertical guideways in which move up and down a rear gauge and the carriage for the knife. This carriage consists of a horizontal part and a vertical part, the latter sliding up and down in supplemental guides. The vertical part of the carriage has two forwardly converging walls of V-shaped cross section to which the knife is attached, its lower edge being adapted to give a shearing cut when it descends. Behind and below the knife a V-shaped gauge is supported on the carriage, the gauge being movable horizontally toward or from the knife, and being adjustable by means of a horizontal screw-threaded shaft having its bearing in the upright part of the carriage, and having a pinion which engages a toothed hand wheel. A connecting bar extends from a bifurcated link from the carriage to the treadle, which is pivoted to a transverse rod rigid with the frame, and when the free forward end of the lever is depressed, the carriage, hand wheel, shaft, gauge, and knife are drawn down. They are restored to their former position by a weight on the rear end of a lever attached to the connecting rod. On the feed table in front of the knife is a gauge having a fixed middle part and hinged wings, all parts of the gauge being adjustable as desired toward and from the knife.

MURPHY'S MITERING MACHINE.

FLUORINE.

We have already given an account of some experiments of Mr. Moissan that permitted him to isolate fluorine. In these experiments he succeeded in splitting up hydrofluoric acid into hydrogen and fluorine. Having again taken up this study, he has been enabled to determine the constant physical principles of this new simple gaseous matter.

Mr. Moissan, in the first place, studied the question as to under what conditions platinum is attacked by fluorine gas. He found that at the ordinary temperature it was possible to preserve fluorine indefinitely in platinum apparatus without any fear of the metal being attacked. Moreover, he demonstrates that at a temperature of 500° or 600° there forms a bifluoride of platinum analogous to the already known chloride of the same metal. This new compound is important, since it possesses the curious property of splitting up into fluorine and platinum through heat. It is likely that when it becomes possible to prepare fluoride of platinum by an indirect way (in starting from hydrofluoric acid, for example), we shall have a chemical process for obtaining fluorine in large quantity.

After his preliminary experiments, Mr. Moissan took the density of fluorine. In order to obtain this gas in abundance, he modified his first apparatus by giving a much greater capacity (Fig. 2). Beyond the electrolyzing tube he arranged a small platinum spiral, designed to condense the vapors of hydrofluoric acid carried along, and, finally, two platinum tubes filled with fluoride of sodium. This compound, in fact, retains the minutest traces of hydrofluoric acid.

The pure gas thus prepared is led into the density bottle by means of small flexible platinum tubes. This bottle is first weighed when full of air, and afterward when full of fluorine. Knowing its volume, it is easy to determine the density of the fluorine therefrom. Mr. Moissan determined the figure 1·26, while the theoretical density is 1·31. The slight difference between these figures well shows that pure fluorine has a normal density.

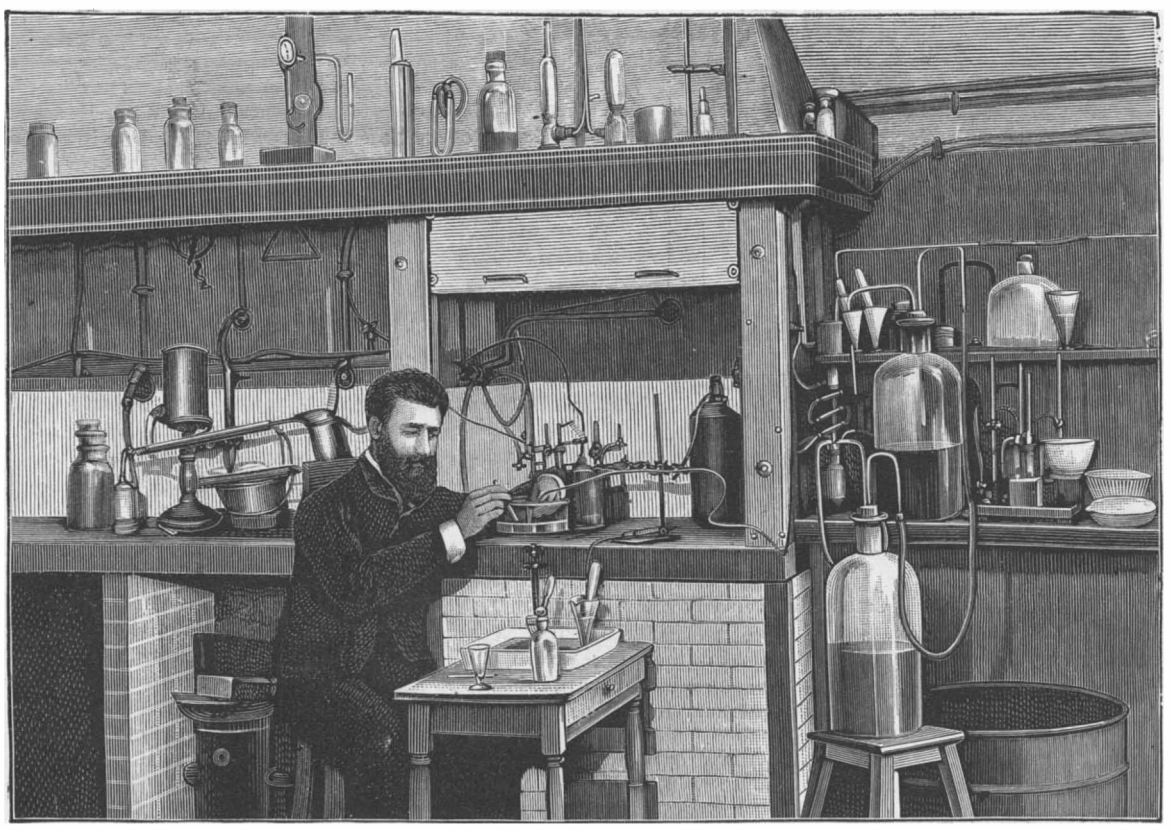

Fig. 1.—MR. MOISSAN PREPARING FLUORINE GAS IN HIS LABORATORY AT THE SCHOOL OF PHARMACY.

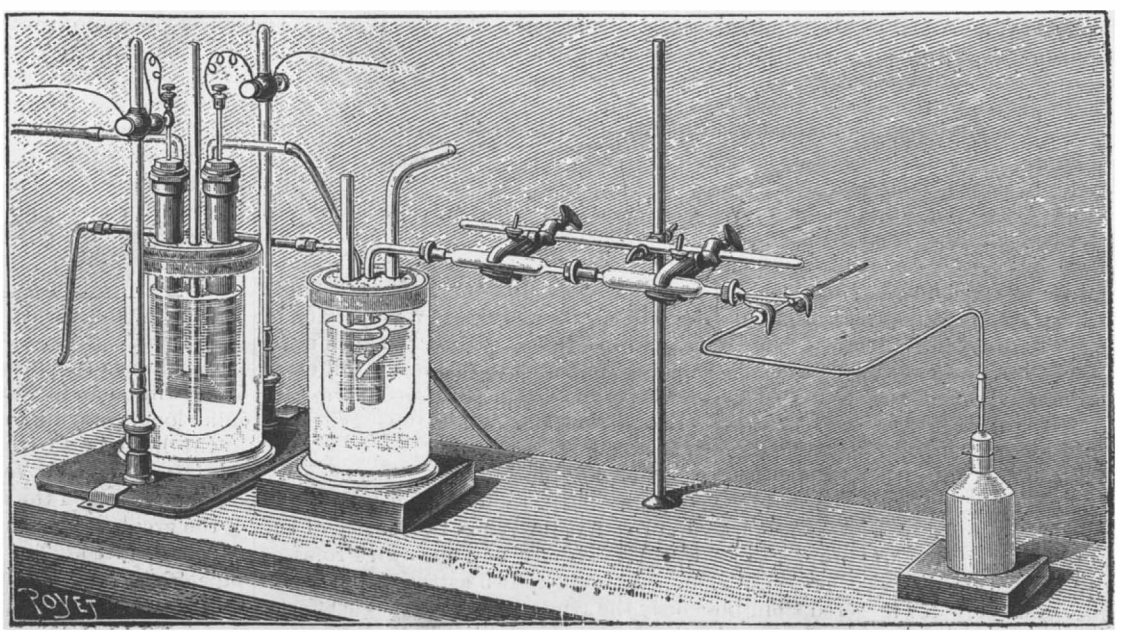

Fig. 2.—APPARATUS FOR PREPARING FLUORINE.

Mr. Moissan next determined the color of the gas. For this he used a platinum tube closed by transparent plates of fluorspar. Two platinum ajutages allowed the gas to enter and make its exit. When the tube was well filled with fluorine, the gas, on escaping through one of the ajutages, ignited crystallized silicium at the ordinary temperature.

Observing the gas, then, through the plates of fluorspar, it was found that it had a greenish-yellow color, and that the latter was paler than that of chlorine seen in the same volume. The color, moreover, differs from that of chlorine in inclining more to yellow.

The spectrum of fluorine also was studied in detail. Upon this subject there had been nothing published except a work by Mr. Salet, who had compared the spectra of chloride and fluoride of silicium. Mr. Moissan caused a very strong induction spark to pass between gold or platinum rods in a small apparatus filled with fluorine. It is unnecessary to add that this small apparatus was itself of platinum, and that the spark could be seen through the transparent fluorspar.

On comparing the results obtained by this new method with those furnished by hydrofluoric acid, fluoride of silicium, trifluoride of phosphorus, and fluoride of carbon, Mr. Moissan has been enabled to demonstrate the existence of thirteen new lines, placed in the red part of the spectrum. These lines are found for the most part in the red portion comprised between the second line of potassium and the line of lithium, that is to say, in a part where no simple body has hitherto given lines. Finally, Mr. Moissan adds that with hydrofluoric acid he has obtained several bands in the yellow and the violet; but the position of these bands, which are not very well defined and are very wide, could not be exactly determined.

Comparing these researches with those undertaken by Mr. Meslans upon the fluorate ethers of the ethyl series, it will be seen that fluorine is clearly placed at the head of the chlorine family. It is colored the same as all the compounds of this family, but not so deeply as chlorine. Its density is normal and the fluorate ethers have a boiling point less by about 50° than the corresponding chlorate ethers.

What renders these researches very curious is not only the interest attached to the isolation of the new simple matter that has been obstinately sought for for a century, but the fact that this gas is the most active matter that chemists possess. In fact, it ignites crystallized silicium, which boiling nitric acid does not attack, and which pure oxygen burns with difficulty at a high temperature; and, while chlorine is incapable of directly combining with carbon, fluorine is capable of uniting with it and forming a gaseous body—fluoride of carbon, which Mr. Moissan will soon describe

Another experiment recently described further demonstrates the chemical activity of fluorine. When into the tube filled with fluorine that served to determine the color of this gas a drop of water is allowed to fall, a decomposition of the water occurs and hydrofluoric acid forms, with a disengagement of ozone—the latter being of the characteristic blue tint that Messrs. Hautefeuille and Chapuis have demonstrated to belong to oxygen very rich

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in ozone. This is the sole chemical reaction that furnishes so concentrated ozone.

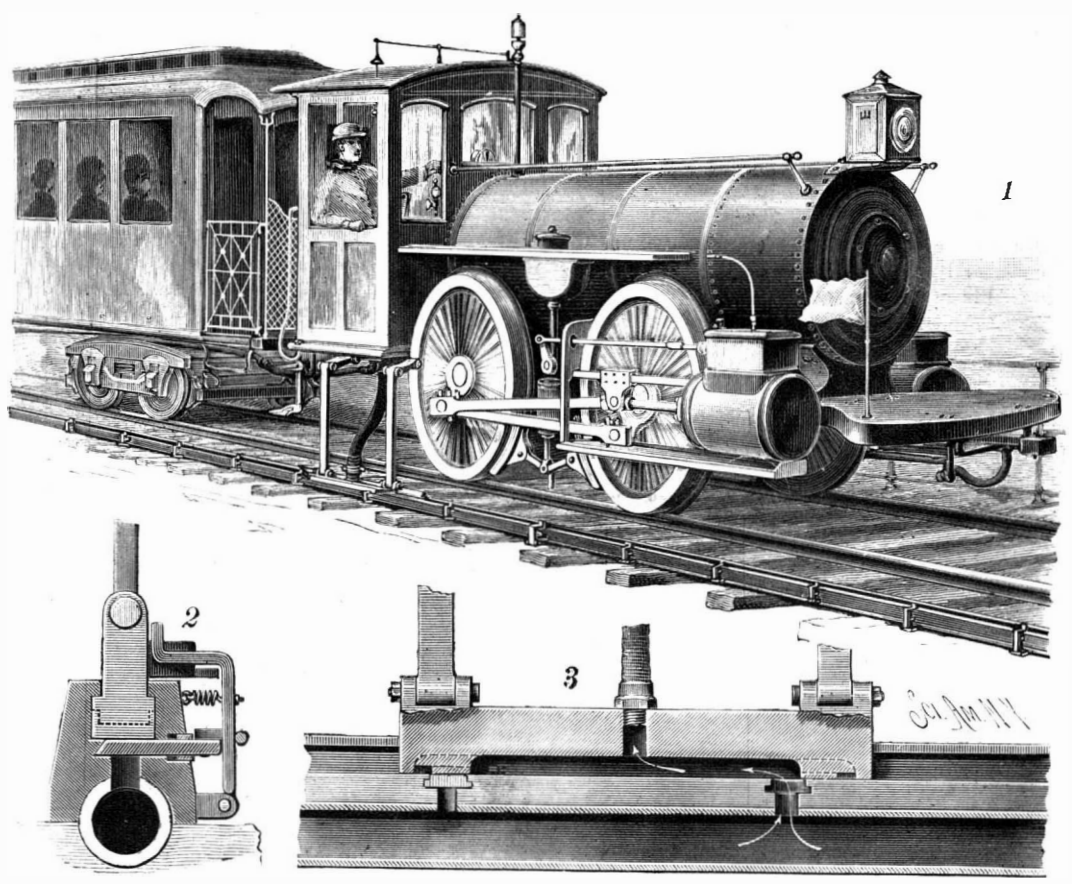
Finally, we may add that fluorine and hydrogen combine when cold and in darkness. This is the first example of two simple gaseous matters directly uniting without the intervention of a foreign energy. In fact, chlorine and hydrogen require light, hydrogen and oxygen require an electric spark or a flame, and hydrogen and fluorine combine directly

Moreover, this chemical activity has been very clearly demonstrated by Messrs. Berthelot and Moissan, who have determined the heat of combination of hydrogen and fluorine to be 37·6 calories, that is to say, much greater than that of the other hydracids formed by iodine, bromine, and chlorine. Upon the whole, fluorine is the most active element known up to the present, and on account of this very property, it is certain that it will be called upon to furnish chemists with the most interesting reactions.—*La Nature.*

IMPROVED MEANS OF DISTRIBUTING POWER.

A means of conveying steam or compressed air along a line of road, to be delivered to a motor propelled thereon, is illustrated herewith, and forms the subject of a patent issued to Mr. Victor H. Tomlinson, of Hudson, Col. Fig. 3 is a central longitudinal sectional view of a section of the apparatus, Fig. 2 being a cross sectional view. In the upper face of the pipe or tube to which the motive agent is delivered from a central station are castings with undercut grooves, the castings being arranged end to end throughout the length of the tube, and having ports registering with ports in the tube. Within the undercut groove of the casting is a receiver with grooves to receive any proper packing, the receiver having a flexible pipe leading to the steam chest of the motor or a reservoir carried thereby. The receiver is held to the motor by upwardly extending standards, and as the receiver is forced forward by the onward movement of the motor, a forward valve is opened as another at the rear is closed.

The ports in the pipe at the side of the track are controlled by valves engaged by spring-pressed levers, and a pipe leads to the steam chest of the motor, or the reservoir carried thereby, the distance between the ports being about equal to the receiver recess. The way to this recess from the pipe at the side of the track is opened by a lever as the motor moves forward, one of the valves being opened as another at the rear is closed. The economy of this system of supplying power will be readily appreciated when it is considered that steam can be generated or air compressed at a central station at a rate usually not more than two-fifths of the cost of generating such power on an independent traveling motor. The cleanliness of such a system, and the absence of noise, would also form striking advantages in favor of its adoption for the propelling of street cars, while its cost need not necessarily be higher than that of cable traction or electricity.



TOMLINSON'S APPARATUS FOR SUPPLYING COMPRESSED AIR TO LOCOMOTIVES.

Interesting Lecture on Japanese Mirrors.

On the evening of April 10th, Prof. Thomas C. Mendenhall, President of the American Association for the Advancement of Science, and Superintendent of the United States Coast and Geodetic Survey, delivered a very interesting lecture on Japanese mirrors, in Brooklyn, N. Y., before a large and appreciative audience, composed mainly of members of the Brooklyn Institute.

Prof. Mendenhall began his lecture by giving the history of mirrors, especially those of Japanese manufacture. He related in brief the myth in which the origin of the Japanese mirror was described, and which also explained how the mirror became an object of worship in Japan.

The sun goddess, who in ancient times lived in Japan, had control of various matters; among others, that of sunlight. This goddess had frequent difficulties with her brother, and on one occasion became so enraged that she retired into a cave, and closed the mouth of the cave with a stone; in consequence of this, darkness reigned in Japan. The citizens of the country made every effort to induce the goddess to withdraw from her hiding place, but to no effect, until a genius of that country conceived the idea of making a mirror. He at once attempted the task, and in a short time produced a bronze mirror with a highly polished surface. Thereupon the citizens formed a plan for inducing the fair goddess to leave her place of seclusion. They proceeded to the mouth of the cave, and with music and dancing gave audible evidence of having a very enjoyable time. The goddess, with true feminine curiosity, moved the stone slightly from the mouth of the cave, so as to enable her to peer out and see what was going on. On inquiry she ascertained that the people had found a goddess more beautiful than herself. Her jealousy being excited, she moved the stone still further, to enable her, if possible, to see the new object of admiration, when the people held the mirror before her face, and she beheld the reflection of her own countenance. Appreciating the great compliment she withdrew herself from the cave, and Japan was again favored with sunlight.

In the course of time the sun goddess departed from the country, after having instructed the people to worship in her stead the mirror which she would leave behind her. It is said that the identical mirror in which this goddess beheld her own countenance is still in existence in one of the temples of the country.

Prof. Mendenhall said this was the explanation of the existence of the mirror and its use as an object of worship, but he would not venture to explain the incongruities of the story. He said the mirrors were made of a bronze formed of copper and tin in the proportions of about 75 parts of copper to 25 of tin. The metal was cast in a mould, and the mirror was prepared for use by first scraping it roughly with a tool, then dressing it with a tool which acted partly as a scraper and partly as a burnisher. By this means the surface of the mirror was gradually reduced to a smooth and nearly plane surface. The next operation was that of polishing, which was accomplished by means of certain polishing powders. The final finish was given to the mirror by applying to it a very slight coating of mercury by means of a piece of charcoal and a vegetable acid. The fruit acid was prepared from the juice of the plum. It insured a perfect union of the mercury with the surface of the bronze.

It was discovered many years ago that some of these mirrors would reflect from their polished surface an image corresponding to the ornamentation on the back of the mirror, while this image could not be discerned upon the reflecting face of the mirrror. These mirrors were known as "magic mirrors." Prof. Mendenhall said that in selecting a magic mirror it was necessary to reflect the sunlight upon a surface from the mirror, and he early discovered that it made a remarkable difference in the price of a mirror if it was capable of producing an image upon a wall He therefore conceived of another plan of selecting magic mirrors, which consisted in viewing the reflection of a pair of parallel lines, such as two edges of a moulding. If these lines remained parallel when reflected from every portion of the mirror, it had no magic properties; but if, on the other hand, the lines were seen to diverge in different places with the mirror in certain positions, it was laid aside for further examination, and it was generally found to be a true magic mirror.

The explanation of this curious effect has been attempted by many physicists, some of whom thought the effect was due to the difference in density of the bronze, but a French physicist and our own Professor Charles A. Young, the well known astronomer, discovered simultaneously the true cause of the magic effects. It was found to be due to inequalities in the surface of the mirror, undiscoverable by direct inspection. In the manufacture of the mirror, the scraper and burnisher produced the effect of stretching the surface of the thinner portions of the metal, so as to render them very slightly convex; while the thicker portions retained their plane surface, the convex portions of the mirror dispersed the light, while the plane surfaces reflected the light in parallel beams. The Japanese mirrors having magical qualities are always found to be thin.

Professor Mendenhall projected by the aid of an electric light a number of reflections of mirrors having different figures upon their back surfaces. In many of the images on the screen figures like those on the back of the mirrors appeared sharp and clear.

While professor of physics in the Imperial University of Japan, at Tokio, Prof. Mendenhall had every opportunity for studying the manufacture of these curious objects. He succeeded in having a magic mirror made to order, notwithstanding the assurances of the manufacturer that it was impossible. This mirror was projected on the screen. The figure consisted of a series of checks. To show how a slight distortion on the surface produced a material change in the form of the figure on the screen, Prof. Mendenhall heated the center of this mirror by means of a flame. The distortion of the lines and the enlargement of the central squares of the figure upon the screen showed clearly what had taken place in the mirror. Its central portion had been expanded while bound by its cooler periphery, this causing the central portion to bulge out and produce the effect described. He produced similar effects by merely touching the back of the mirror with a pencil. To more clearly illustrate the effects of bulging in the center of the mirror, a piece of plane glass mirror, having upon its surface two black parallel lines, was placed in the beam of the electric light. The bending of the mirror so as to render it very slightly convex caused the lines to separate upon the screen and the light to be perceptibly lessened, while the bending of the mirror in the opposite direction exhibited a concentration of the light and the approach of the black lines toward each other.

Prof. Mendenhall said that the manufacture of bronze mirrors was retained in the families of the mirror makers for generations. The magic mirror having the checks was made to order by a member of the seventh generation of mirror makers.

Although glass mirrors are being largely introduced into Japan, they have not displaced the bronze mirrors, nor can they do so, so long as the beliefs and practices of the Japanese remain unchanged.

At the close of his lecture Professor Mendenhall mentioned the fact that the magic mirror involved the principle which is now being applied in the invention popularly known as "seeing by electricity." At one end of the line is placed a mirror made up of series of minute strips of steel behind which is arranged a corresponding series of small electro-magnets. At a distant station the line was connected with an instrument formed of a multitude of selenium cells connected electrically with the magnets behind the steel mirrors. Selenium has the property of having its resistance changed by the action of light. A strongly illuminated object placed in front of the selenium receiver changes the resistance of the instrument at the points of illumination, so that currents of different strength are transmitted to the magnets of the receiving instrument. These magnets bend the steel mirror so as to produce temporary effects similar to those produced permanently in the magic mirrors. A light reflected from the steel mirror shows an image representing with more or less accuracy the object in front of the selenium transmitter.

A Steel Flume.

The flume of the Spokane Hydraulic Mining Company will be an immense steel pipe four and one-half miles long, carrying water from the old California ditch, at the head of Pritchard Creek, in the Cœur d'Alene mining district, above Murray, to the Old Wash gold diggings. When the flume is completed, it will be one of the greatest feats of hydraulic mining engineering ever attempted. The flume will be made of heavy steel pipe, 22 inches in diameter. It will give a tremendous pressure, and will reopen some of the old placer mines, which are the richest in the Cœur d'Alene.

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RECENTLY PATENTED INVENTIONS.

Engineering.

STEAM ACTUATED VALVE.—Benjamin R. Patten, Nova Scotia, Canada. This is a valve for steam engines and steam pumps in which a piston valve is held to travel in the steam chest and has two pistons connected with each other by arms, of which one has a flat upper side which forms a valve seat on which is held a flat auxiliary slide valve, a valve stem to which the auxiliary valve is attached being operated from the cylinder piston.

GUARD RAIL FOR LOCOMOTIVES. — Joseph A. Woodmansee, New Vienna, Ohio. This is a rail held to slide in suitably arranged keepers on the sides of the tender in such a manner that it can be quickly drawn forward across the entrance opening between the cab and tender, to prevent the fireman or engineer falling off the locomotive while in motion.

Railway Appliances.

CAR.—Orlando Harriman, New York City. This car has upper end compartments extending across the car, and upper side galleries extending between them, with other novel features, to increase the sleeping and seating capacity, and so locate the smoking room that smoke will not penetrate the body of the car, while passengers will be provided with a better view from the car than can be had with the ordinary construction.

SAFETY CAR.—Jacob W. King, Bowling Green, Mo. This is a car with a bullet-proof compartment filling one end, the compartment having a convex front with vertical flutes furnished with knife edges or cutters to receive and cut the bullets, while the compartment has loop holes through which the inmate may fire.

VENTILATOR FOR CARS. — Orlando Harriman, New York City. This invention covers the construction of a longitudinal opening in the roof of the car, with a trough-like structure having ventilators on its sides depending from the roof below the opening, making a material increase in the head room of the car, and designed to afford as perfect ventilation as was obtained by the old form of ventilating dome.

Mechanical.

PULLEY. — Francis M. Powell, Frederick, South Dakota. The rim of this pulley has parallel radially slotted flanges, a series of independent blocks forming an expansible working face, while disks on the hub inclose the outer side of the slotted flanges and have spiral grooves engaging the ends of the blocks, the pulley being easily changed while in motion to increase or decrease its diameter.

RIVETING MACHINE. — Reinhold A. Carl, Hearne, Texas. This is a machine for attaching metal rivets to leather or other materials to fasten them together, the invention covering various novel details and combinations of parts and the rivet used having a flat head, a round stem, and a sharp point.

COMBINATION GAUGE. — William B. Little, New York City. This is a wood worker's gauge in which a tubular longitudinally slotted stock has fixed and adjustable marking points and an adjustable fence on the stock, combined with an external slide having an internal and an external point at its outer end, the combination comprising a mortise gauge, a cutting gauge, two marking gauges, a gauge for ogee or half-round moulding, and a gauge to go around the inside of a circle from five eighths of an inch upward.

Miscellaneous.

SUSPENDERS. — Adam Schieffer, New York City. This invention is designed to provide suspenders of a simple and durable construction, wherein the elastic portion will not be injured by contact with the body of the wearer.

MUSICAL TOY. — Reinhold Handel, Leipsic, Saxony, Germany. This is a device wherein, upon the rotation of a series of wings, as the toy is moved about in the air, a striking arrangement connected with the wings is made to successively raise and release a series of metal reeds and cause a melody to be played.

BAGATELLE BOARD. — Jasper H. Singer, New York City. This is an inclined board having a revoluble pointer, with means for shooting the ball about the board, the pointer being arranged between the mouth of a side alley and the foot pockets, whereby the alley ball during its gravitation down the face of the board toward the foot pockets may collide with the pointer, causing it to point to a designated number or space.

TRAP.—Henry B. Eareckson, New York City This is a trap for sinks, laundry tubs, bath tubs, etc., the invention covering a novel construction and combination of parts designed to prevent any foul air and gas from entering the building, while the working of the valves can at all times be conveniently observed through glass-covered caps.

UTERINE REPOSITOR. — Murdoch Chisholm, Halifax, Nova Scotia, Canada. This instrument is formed of two pivotally connected levers, one having a slot near its free end, while a sound is pivoted to the end of one of the levers and adapted to be swung by the other lever.

BLASTING CARTRIDGE.—Albert Palle, Paris, France. This cartridge is made with a paper shell containing a slow explosive and an inner metallic shell of tin or lead embedded in the outer explosive, and containing glycerine or other matter, not explosive by itself, but which will unite with the slow-burning explosive when the latter is ignited and form a rapid explosive.

PNEUMATIC TELEPHONE. — Joseph G. Noreau, Quebec, Canada. This invention provides an indicator having a bell attachment capable of signaling for a length of time to one quite remote, and means whereby when the receiver is removed the alarm will be stopped, the sound being confined to the tubes connecting the mouth piece to the indicator and receiver, the clock work ringing the alarm being automatically wound up when the receiver is disengaged therefrom.

FAN BLOWER. — Martin Williams, St. Johnsville, N. Y. This invention covers a novel construction of the fan casing and the radial wings or blades of the fan proper, to provide a copious supply of air at one or more points between the ends of the blower shaft, to re-enforce the usual supply afforded at the sides of the casing of the fan around the shaft ends.

ADDING MACHINE. — James F. Mays, Birmingham, Ala. This is an improvement on that form of machine in which a rotating disk has numbers in a circle from 1 to 100, each number having a hole to receive a pencil point, the disk having on its face also a spiral groove which, as the disk is rotated by successive additions, causes an indicator traveling in the groove to move up and register on a scale the amounts added.

PADDLE WHEEL. — James Cobban, Brooklyn, N. Y. This wheel has buckets between which plungers are mounted, with mechanism to force the plungers outward, so that their peripheral faces will be in alignment with the general peripheral face of the wheel, forming a propeller which may be mounted beneath the surface of the water either at the side or the stern of a vessel.

MACHINE FOR PACKING SHINGLES. — Herman L. Fehlberg, La Crosse, Wis. This is an automatically working machine designed to pack shingles as they are fed in after being jointed, the machine being easy to manipulate and the invention covering various novel features and combinations of parts.

BRAKE FOR VEHICLES. — Winfield S. Jobes, West Leisenring, Pa. This invention covers a mechanism designed to be operated manually from the sides or one end of a car or wagon, a bail-shaped lever being pivoted by the ends of its limbs to the sides of the body, in combination with a rock shaft having two crank arms to which inclined shoe-supporting arms are affixed, links connecting the crank arms to the limbs of the bail-shaped lever.

TIRE ADJUSTER. — George Surratt, Gainesville, Texas. Combined with terminal tire lugs having right and left screw-threaded sockets is a right and left screw stem, a turning block of the same cross section as the rim of the wheel, connected to the screw stem, to slide thereon, for locking the turning block to the terminal lugs, the device tightening the tire when it becomes too loose and expanding it when it becomes too tight.

FILTER.—Ferdinand Lascar, New York City. This invention provides an apparatus from which the filtered water will pass off with the same amount of air as when admitted, and has an accumulating chamber in which the gross impurities will be left, the water passing therefrom to the main filtering mass, the construction being designed to furnish a sparkling potable water of the highest purity.

VALVE. — Charles H. Shepherd, New York City. Combined with a valve having a convex face is a pipe having a valve seat upon its end, with an annular ledge extending toward the face of the valve without touching it, the valve being especially designed for use in connection with the outlet of a house pipe, the valve being arranged to discharge into a catch basin.

AUTOMATIC PLUG FEEDER. — James J. Powers, Brooklyn, N. Y. Combined with a vat in which liquid is permitted to rise and fall, and an elevated tank, is a cock having a rotating plug fitted in a pipe leading into the tank, a float lever being applied to the cock to turn the plug as the float lever descends, the invention being an improvement on a former patented invention of the same inventor, for use particularly in feeding chemical disinfectants to sewage vats.

STOVE CASTER. — William H. Vance, Little Britain, N. Y. This caster has a bracket frame formed from elastic metal and with depending perforated flanges, a pintle bolt passing through the flanges and having a nut, the bolt being adapted to compress the flanges and clamp the caster wheel, whereby the stove may be firmly held in the place where it is located.

LIQUID ATOMIZER. — Lucien P. Lasmolles and Jean E. Frechon, Nerac, France. This is a portable apparatus consisting of a frame supporting a liquid chamber and other parts of an atomizer especially designed for use in atomizing liquids for destroying disease in grape vines.

COFFEE POT. — Harry B. Cornish, Jackson, Tenn. This pot has an open-ended tapering infusion vessel, with an upwardly arched frame in its lower end, with a tapering clamping ring to clamp the straining cloth around the arched frame, the strainer supporting the ground coffee so that the water will percolate through it.

PRODUCING TUCKS ON FABRICS. — Louis Loeb, Jr., Rorschach, Switzerland. This invention covers an improved method of producing tucks of straight, scalloped, angular, circular or other form, without requiring the main fabric to be be made longer or wider than the finished tucked piece, the tucks being so formed as to assure safety against ripping by use or washing the fabric.

MUCILAGE BOTTLE.—William R. Cole, Pottsville, Pa. This bottle has a cup stopper with a slotted lip or cap for the brush, the whole device forming a cleanly, convenient and economical receptacle for the holding and use of mucilage in offices or elsewhere.

GAME BOARD.—Gideon Bixler, Wooster, Ohio. This is a box-like structure having its bottom inclined from the center in opposite directions, and provided with a shoulder or stop at the junction of the inclines, the board to be used with two sets of balls of different sizes, the object being to cause all of one set to occupy the space at one side of the ridge and those of the other set at the opposite side.

TOY. — James D. Fahnestock, Cincinnati, Ohio. This is a board with side flanges and having at one end a series of pockets in a triangle, within which are other pockets, the board to be used in connection with a series of balls and an inclosing casing, the pockets being numbered, and the player getting the balls in the pockets adding up the highest total winning the game.

HAIR PIN. — Michael Cashin, Rifton Glen, N. Y. This is a tubular pin having a wire rod within the tube, the rod having a spirally coiled globular head, by compressing which a roughened portion of the rod will engage the hair and retain the pin in place.

OBSTETRICAL FORCEPS. — John N. Reimers, Calumet, Iowa. These forceps have their arms pivoted and provided with jaws having prongs or teeth projected from the inner side of the ring surrounding the opening.

OBSTETRICAL FORCEPS. — James R. Brown, Springfield, Mass. These forceps have two members pivotally connected between their ends and bent downwardly and forwardly in front of the pivotal point, the rear ends of the members having hand pieces extending downwardly to the longitudinal plane of the blade.

NEW BOOKS AND PUBLICATIONS.

PRACTICAL NOTES FOR ELECTRICAL STUDENTS. Vol. 1. By A. A. Kennelly and H. D. Wilkinson. London: The *Electrician* Printing and Publishing Company, Limited. 1890. Pp. xii, 308.

This work is an eminently practical one, and, although it is only the first volume, yet, as far as it goes, it represents a complete treatise. It aims at the simplification of the subject of electrical measurements, and by the use of diagrams and illustrations, with as little mathematics as possible, it fairly attains its ends. The diagrams of the lines of force, and the illustrations in general, appear fresh and new, and little is to be recognized in it of the old type of illustration to whose use the writers of text books are so addicted. The work is well worthy of the perusal of all interested in the subject.

ESSAYS OF AN AMERICANIST. By Daniel G. Brinton. Philadelphia: Porter & Coates. Pp. 489. Cloth. Price $3.

Ethnology and Archaeology, Mythology and Folk Lore, Graphic Systems and Literature, Linguistics, are the subjects of the very interesting monographs contained in the present work. It is to be highly recommended to those interested in American archæology and anthropology, and its very elegant printing and popular style make it a work which will be widely appreciated. The author has been very successful in avoiding anything like a dry style in the treatment of his subject, and the interest is thoroughly maintained throughout.

PRACTICAL BLACKSMITHING. Compiled and edited by M. T. Richardson. Vol. II. New York: M. T. Richardson, publisher. 1889. Pp. 262. Price $1.

The first volume of "Practical Blacksmithing" having exhausted the generalities of the subject, the second volume is devoted more especially to the consideration of the implements. The tools used in the shop are, therefore, given a very full and exhaustive treatment. Besides this, all other classes of instruments are illustrated, and the shapes of points of cutting tools are considered, all classes of cutting tools being included. A good deal of practical information, such as the method of mounting a grindstone, is to be found in its pages. The third volume, which is yet to appear, is to be devoted to the consideration of jobs of work.

GIBB'S ROUTE AND REFERENCE BOOK OF THE UNITED STATES AND CANADA. New York: Bibb Bros. & Moran. 1890. Pp. 251. Price $5.

The shortest routes from place to place are marked in the present volume upon a large series of maps. Tables are given for each district, of the number of firms engaged in the different classes of trades in the principal cities, while a list of hotels in the largest cities, with their rates for board, forms another series of tables. The book is of very great use for all who have to travel, but it is compiled especially for the use of commercial men.

DISEASES OF PLANTS. By H. Marshall Ward. London: Society for Promoting Christian Knowledge. Brighton: New York. Pp. 296. Price $1.

A popular account of about twelve prominent diseases affecting plants forms the basis of this treatise. They are treated very interestingly from the biological standpoint, and numerous illustrations make their presentation an exceedingly careful one. It purports to be published as a contribution to the "Romance of Science" series, and in spite of its comparatively dry title it really does fall under the category claimed. It is indexed so that this essential feature is supplied to the reader.

ELECTRIC LIGHT INSTALLATIONS AND THE MANAGEMENT OF ACCUMULATORS. By Sir David Salomons. London: Whittaker & Co. New York: D. Van Nostrand Company. 1890. Pp. 334. Price $1.50.

Mr. Salomons' hand book is too well known for this new edition to require any notice from us. It is revised and enlarged and presents an eminently practical view of its subject.

PRACTICAL TYPEWRITING BY THE ALL-FINGER METHOD, WHICH LEADS TO OPERATION BY TOUCH. By Bates Torrey. New York: Fowler & Wells Co. 1889. Pp. 64. Price 50 cents.

The present book is by a disciple of the all-finger method of typewriting. It is prepared especially as a guide for the operator of the Remington machine, but, of course, a great deal is said which will apply to all. As a systematic study of the science of typewriting it will have a very wide interest. A feature of special interest are some diagrams for the headings of documents and for ornamental effects to be produced on typewriters.

THE LOCOMOTIVE. Hartford, Conn. 1889. Pp. 192, iii.

This is a bound volume of the journal published by the Hartford Steam Boiler Inspection and Insurance Co., representing the numbers issued in 1889, and an index thereto. A number of illustrations and the descriptions of boiler explosions make it of value to engineers.

TRAITE THEORIQUE ET PRACTIQUE D'ELECTROCHIMIE. By Donato Tommasi. Paris: E. Bernard & Co. 1889. Pp. 240.

The much neglected subject of electro-chemistry in all its details is treated of by the author. This is the first part only of the work, which is to be completed in three parts. The subject is excellently treated, and its fullness gives the work standard value for the scientific library. The thoroughness of the work is evident on the most cursory inspection, and too much cannot be said in commendation of its printing and general appearance.

ALGEBRA. AN ELEMENTARY TEXT BOOK FOR THE HIGHER CLASSES OF SECONDARY SCHOOLS AND FOR COLLEGES. By G. Chrystal. Edinburgh: Adam and Charles Black. 1886 and 1889. Volumes I. and II. Pp. xx, 542 and xxii, 588.

An algebra such as the present one is so complete, and all its parts are worked out in such great detail, that it cannot well be reviewed. The eminent standing of the author is the best proof of its value. As it stands, it may be considered one of the leading algebras of the day,

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APRIL NUMBER.—(No. 54.)

TABLE OF CONTENTS.

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7. Elevation and floor plans of a brick cottage. Cost about $5,000.
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9. View of an economical water tower at Hill View Park, South Yonkers, N. Y.
10. A cottage at Mountain Station, N. J., from designs by F. W. Beall, architect, New York. Cost complete $8,000. Plans and perspective.
11. Two carriage houses. Cost about $1,500.
12. Two pages of illustrations showing in general view and detail the wreck of the tower of the Church of the Covenant, at Washington, D. C., which fell when nearly completed on August 22, 1888.
13. A Crescent Place, South Yonkers, N. Y., residence, recently erected at a cost of $7,500. Plans and perspective view.
14. Miscellaneous Contents: Concrete arches.—Dwarf cannas.—Water works for small towns.—Soft stone.—Brick pavements.—Fall of the tower of the Church of the Covenant, Washington, D. C.—Improved duplex plumb and level, illustrated.—Improved anti-friction hanger for sliding doors, etc., illustrated.—Wood's pedal valve for radiators, illustrated.—An improved turnbuckle, illustrated.—Improved copying press, illustrated.—The Wing disk fans, etc.—Mortising and Tenoning machine, illustrated.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(2096) H. H. L. writes: 1. Can I make a porous cup of plaster of Paris? A. As a temporary affair you can. It is well to use drilling or heavy muslin as a basis for the sides. 2. How is the porous cup of a Leclanche battery fixed inside? A. It contains a plate of carbon surrounded by a mixture of graphite and pyrolusite sifted free from dust. 3. Will a bichromate of potash battery work, if the zinc is not amalgamated? A. Very poorly and wastefully. 4. What size wire should be used for an electric bell magnet? A. No. 22 to 24 are good sizes.

(2097) J. S. C. asks: 1. Will you please tell me in your query column the exact weight and value of one cubic inch of pure gold? A. 0·6965 to 0·7003 lb. avds. or 10·16 to 10·21 troy oz. It is worth 20.67\frac{183}{1000}$ an oz. 2. Also, what is a simple method to prevent the sheets of paper, as they are thrown from a press, from clinging to each other by electricity, which makes it difficult to "jog" or straighten them? A. No effectual way is known. Dampness of the air or paper tends to prevent it. 3. Can the electricity generated by a heavy moving belt be used to illuminate an incandescent lamp? A. No.

(2098) A. M. K. asks for (1) the process of obtaining stereotypes from printed pages without the use of type. A. It is done by a photographic process, such as described in our SUPPLEMENT, No. 344, and many others. 2. Give me formula for the best binder's glue, which is used in binding books. A. Use best carpenter's or white glue, to which, after soaking and heating, one-twentieth its weight of glycerine is added.

(2099) J. H. asks the directions for skeletonizing leaves and flowers. A. The leaves are soaked in water until the cuticle loosens. It is stripped off with a brush on one side. The leaf is then turned over and the other side freed. By proper manipulation the pulp is pushed out by vertical strokes with a brush. The leaves are handled on plates of glass or on cards on which they are floated. To reverse them they are placed again in water and turned over. Javelle water may be used to bleach them. 2. Why is it a professional rat catcher can put his hand in a trap or sack full of rats and they will not bite, and what kind of oil does he use that draws them? A. Oil of rhodium is said to be used by professional rat catchers. Confidence probably accounts for much of their success.

(2100) G. H. L. asks: 1. How many cells of Leclanche battery (Sampson, Gonda, etc.) will be required to run simple electric motor? I am making one, and will use it only at intervals for light work, such as polishing, drilling, grinding, etc., probably not over a half hour at any one time. How long will above battery run full force, and how long rest required before using again? A. None of the batteries referred to are adapted to running the simple electric motor. It requires a large current, such as you can get from a large plunging battery or a nickel-plating battery. 2. Would a cell of 8 or 10 carbon pencils ½ in., surrounded by cylinder of sheet zinc in sal-ammoniac solution, give good results? A. No. 3. How to ascertain the resistance of a battery or coil of wire? A. For methods of measuring resistance we refer you to electrical books. 4. What rule is there for number and arrangement of batteries to give maximum power to motor or magnet, resistance of coil and batteries being known? A. See "Electrical Calculations," page 179, current volume SCIENTIFIC AMERICAN.

(2101) R. G. B. says: I am making a photo camera, in the interior of which brass work and a mirror are to be used. What must I use to give the brass a dull jet black, and what can I paint the inside of camera with. Would black walnut be a good idea? A. For blacking the interior of the camera for both wood and brass use fine lampblack ground with alcohol to the consistency of very thin paint. Then add a few drops of shellac varnish, mix well, and try it on a piece of metal; if right it should not wipe off nor have a shining or reflecting surface, which will guide you as to adding more shellac or alcohol black. 2. I require a small mirror which must be light, and not to exceed 1-64 inch to 1-32 inch in thickness. Is there any substitute for glass, and if not how could I make one of very thin glass? A. You can obtain thin glass from the opticians and can silver it by sliding it upon a piece of pure tin foil covered with mercury, or by the chemical method as described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 105.

(2102) L. P. S. asks: 1. What is the cause of the sparking at the commutator of a dynamo or motor? A. It is due to the extra current discharged from the coils of the armature and field magnet. 2. Does it injure the armature? A. It gradually burns out the commutator and the brushes. 3. How can the sparking be stopped? A. Sparking does not occur to any appreciable extent in a well built dynamo or motor, provided the brushes are properly adjusted. The brushes should be at diametrically opposite points on the commutator.

(2103) W. H. S. asks why, in making a permanent horseshoe magnet of a piece of steel, the current is shut off several times during the operation. A. Several applications of the current, especially if it is not sufficient to readily saturate the magnet, are more efficient than one application. If the current is so strong as to magnetize the bar to saturation, one application is sufficient. 2. Books of instruction tell us that in order to make a permanent magnet, a steel of horseshoe shape is wound with an insulated wire and then charged. Now if such be the case, how can the wire, being insulated, affect electrically the steel within its folds? A. Magnetism is produced by induction from the current passing through the wires. There is no insulator that will shut off the magnetizing effect of the electric current.

(2104) Bicycle asks: Can you tell me how to make a good black enamel to put on to a bicycle when the original enamel has worn off, something that will finish hard and smooth? A. Bicycles are japanned and baked in an oven to about 500° Fah. You can best repair by patching with japan varnish and baking hard, then smoothing the surface with sand paper, and with another thin coat over all, make a uniform finish and bake in an oven as before. Purchase the japan varnish through the varnish trade; you will fail in trying to make it.

(2105) W. S. T. says: Please inform me what the matter is with a water glass; it is mounted on a column, and if the top gauge cock is opened so as to let the steam out the water in the glass will show the water in the boiler, and in half a minute or so will go up to the top, and the glass is full when there is but one gauge of water in the boiler. A. The exit of steam through the gauge cock lessens the pressure in the column, which causes the water to rise, to balance the difference in pressure between the boiler and column.

(2106) G. B. writes: Suppose a given quantity of hydrogen below its critical temperature were to be liquefied by pressure. Further suppose twice this quantity of hydrogen, kept above its critical temperature, were to be subjected to a sufficient number of atmospheres to reduce it to the same volume occupied by the liquid in the first supposition. In this case would not the gas be more dense or of greater sp. gr. than the liquid, *i. e.*, if you disregard the difference in the conditions of each? A. The gas would be of double the specific gravity of the liquid. The conditions of each have nothing to do with the question as put.

(2107) G. H. asks: Will you inform me how to trisect any incommensurable arc? A. It can only be done by tentative methods or by a protractor.

(2108) W. W. V. asks: 1. Will amylic or methylic alcohol answer for blowpipe work? A. We recommend for analysis an oil lamp burning sweet almond, colza, or cotton seed oil. For mechanical work either of the alcohols mentioned will answer, but will be very disagreeable. Inhalation of amylic alcohol vapor is injurious. 2. What are the latent heats of vaporization of the above? A. For the latter, 263·70 gramme degrees Centigrade. 3. In the telephone described in SUPPLEMENT, No. 142, does it make any difference if the magnets are not very strong? A. The magnets should be strong. 4. Please give some means for testing the purity of sweet oil. A. There is no simple test, and even those performed by a chemist are not always reliable. 5. Is the African explorer's name Henry M. Stanley, or is that his *nom de plume?* A. His parents were named Rowlands. He took the name of an adopting parent. See SCIENTIFIC AMERICAN, December 21, 1889. 6. Will common sewing needles do for an astatic needle galvanometer? A. Yes. 7. If I make the bobbin 2 inches long and 1⅛ inch wide, with three-sixteenth inch between the wire, and use No. 22 or 23 wire, will it be all right? A. The galvanometer should be wound for the work it has to do. In general use finer wire, No. 30 to 36, and a number of layers. 8. Has anything of any value been done toward producing electricity by direct combustion? A. No; except for laboratory purposes by thermo-piles. An "Electrical Fuel" is described in "Facts Worth Knowing," $3.50 by mail.

(2109) G. A. asks: Would it be wrong to speak of platinum wire as a poor conductor of heat? A. Yes. Platinum is far from being this, although other metals surpass it.

(2110) B. B. asks the heat conductivity through tubes of equal thickness of copper, brass, iron, steel, zinc. Do you know if there ever have been made thorough comparative tests in this regard. If so, by whom? A. The conductivity of the metals is given only by experimenters. The figures given by Desprez are for—

Copper	897
Iron	374
Zinc	363

The experiments of Wiedemann & Franz give for—

Copper	73·6
Brass	23·1
Zinc	19·0
Iron	11·9

Other authorities make—

Copper	89·0
Brass	76·0
Wrought iron	44·0
Zinc	36·0

(2111) W. H. S. asks: 1. Why, in referring to voltaic cells, do the makers say they have an E. M. F. of so many volts? If I am correctly informed, the output or volume proceeding from a cell or dynamo should be measured in amperes, not in volts, and it seems to me that the efficiency of a cell should be measured by the amount of electricity it could produce in a given time. A. Volts express the electromotive force, or the relative producing cause of the current. The latter, measured in amperes, is determined by Ohm's law:

$$\text{current} = \frac{\text{Electromotive force}}{\text{Resistance}} \quad \left(C = \frac{E}{R}\right) \quad \text{Resistance}$$

includes all the resistance of the ciircuit, including that of the battery. A maker should always state this latter, as it is of equal importance in many cases to that of the electromotive force. It is stated generally in ohms. 2. What does the internal resistance of a cell mean? A. It means the resistance offered to the passage of a current from plate to plate, irrespective of any work the cell may be doing in maintaining a difference of potential. It may be expressed in ohms.

(2112) W. H. S. asks: When a cell or battery is short-circuited, what becomes of the electricity that flows through the battery or cell? A. The current expends itself on heating the wire battery solution. You must not attach too material a conception to electricity. It is not a substance. 2. Also what is the effect upon a dynamo to short-circuit same; is this the way it becomes saturated? A. It tends to the production of a very intense current, which heats all parts of the circuit more than the normal current does. It is a good way of starting a dynamo which has lost most of its residual magnetism. 3. Why are telegraph wires not protected with an insulated covering? Are telegraph wires kept charged or saturated with electricity at all times, or only when the impulse is sent over them? A. Because it is not necessary. Air is a very poor conductor of electricity. Whether wires are kept charged or not depends on the system; ordinarily they are not. 4. How many cells would it require to keep in readiness for a message a wire 100 miles long? A. It depends on the system; from ten gravity cells upward would do it.

(2113) E. E. writes: In the SCIENTIFIC AMERICAN of March 8, 1890, page 148, is mentioned a simple storage battery, which can be charged, it is stated, with 12 gravity cells in 24 hours; please answer following queries regarding the same. 1. Will 2 gravity cells be sufficient to charge this storage battery if given longer time? A. The E. M. F. would not be high enough with two cells; better use four. 2. What length of time would it require with 2 gravity cells to charge the storage battery to its full capacity? A. It would take almost two days with four cells. 3. If charged by 12 gravities or by dynamo, would 2 gravity cells running constantly be sufficient to keep it stored, provided that it was only drawn upon for from 3 to 5 minutes each evening? A. You would require four.

(2114) A. E. W. asks: 1. What is the resistance of a coil 3 inches long wound with No. 30 silk-covered magnet wire? Core ⅜ inch thick, winding wire ¾ inch deep. A. The resistance of No. 30 wire is 0·107 ohm per foot, 353·742 ohms per pound. From these data you can calculate the resistance of your coil. 2. How is the resistance arrived at? A. The resistance is generally determined by comparing the unknown resistance with a standard resistance by the aid of a galvanometer.

(2115) C. C. S. asks: What will retard the setting of calcined plaster? I want something to make it set slowly. A. Mix with it, before adding water, from 10 per cent upward of powdered marsh-mallow root.

(2116) E. R. C. asks for a formula for making tooth powder or paste. A. Use best quality precipitated chalk perfumed with orris root.

(2117) Zisca writes: I have a gold ring that has come in contact with mercury and has been thickly covered with it. How can I treat it so as to remove the mercury? A. Heat to a temperature of 700° F. Cautious heating in a candle flame or alcohol lamp should answer. Be careful not to melt the gold.

(2118) G. H. V. asks: 1. Can you tell me what is thought of Graham or whole-meal bread by the best modern American medical men? A. It is thought well of as an article of diet. 2. Is it right to introduce the insoluble bran into the stomach of a dyspeptic, although it may relieve constipation, and does it cause a great part of other food to be passed away undigested? A. The insoluble or indigestible portions of food play an important role, and their introduction into the system is often advantageous. No evil effects should be anticipated from the eating of the bran in Graham flour. 3. Would it be likely to do good or harm in a case of debility and non-assimilation of food? A. For non-assimilation of food we should be inclined to recommend concentrated liquid food and tonics, such as beef tea, malt extract, etc. These would tend to produce constipation. If this appeared, Graham flour and similar diet might be adopted as a panacea.

(2119) J. S. S. asks why a ship is called she. A. It is impossible to say. There seems to be a tendency to personify as female an object characterized by motion.

(2120) V. A. H. asks: Can I buy or can I easily make an indelible ink suitable for marking black silk umbrellas? I prefer a white ink. A. We recommend white oil paint.

(2121) C. J. W. asks: How much cork is necessary for a life preserver to float a person weighing 190 pounds? How should the cork come in contact with the water to give the most support? Will cork chips in canvas bags answer the purpose as well as solid pieces? A. Properly used, a very small piece is enough. In many cases none is required, because by proper management of the lungs one can float unassisted. Eight or nine hundred cubic inches would give very high buoyancy; half that amount would answer. The solid cork is rather the best, and has the advantage that if a hole is made in the canvas, it does not escape.

(2122) S. E. H. writes: What can be added to borax water to prevent it frothing when shaken? When the borax water is spread on a smooth surface with a brush, what will prevent the little bubbles which remain till dry, and leave a rough surface? A. Pour ether vapor over the surface, by inclining over it a wide-mouthed bottle with a little ether in the bottom.

(2123) S. W. asks what proportions of sulphuric acid and mercury to use in an amalgamating zinc for a battery. A. Use 1 part sulphuric acid to 20 parts water and a very little mercury. Rub the mercury on the zincs with a bit of zinc or galvanized iron, or simply rub the plates together with a little mercury between them.

(2124) J. P. W. asks: To what process is milk subjected, to produce what is termed sterilizing? A. It is heated, and sealed up while hot. The heat of boiling water may be used for 30 to 45 minutes, the latter time in hot weather.

(2125) L. F. P. asks: 1. What form of a cheap and simple primary battery would you recommend me to use in running small incandescent lamps of five or six candle power, one battery to a lamp? How many cells of the battery would be needed to operate a six candle power lamp? A. For temporary use six small cells of plunging bichromate battery will answer. 2. Would one six candle power give light enough to illuminate a room 9 × 12 sufficiently for ordinary purposes? A. We think not. A 16 candle power lamp would not be too large for a room of this size. 3. Can electric light carbons be used to advantage in a bichromate of potash battery for the carbon element? A. Yes, if freed from the copper coating.

(2126) L. O. asks: How many and what are the notes of the perfect or natural musical scale, and what are the vibrations of each, per second? A. Seven, as follows:

Name:	C	D	E	F	G	A	B
Number of vibrations:	128	144	160	170⅔	192	213⅓	240
Ratio of vibrations:	1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$

(2127) J. H. J. asks: 1. What are harmonic curves, and is there an instrument for representing them? A. The curve of sines; its construction and the apparatus for drawing it mechanically, are described and illustrated in our SUPPLEMENT, No. 703. 2. The specific gravity of cast copper is 8·79, and that of copper wire being 8·88, what change of volume does a kilogramme of cast copper undergo in being drawn into wire? A. It is reduced by 102-10,000 of its original volume, one hundred volumes of cast copper giving 98·98 volumes of wire. Or taking one kilogramme as representing 11·37 cubic centimeters, the wire would represent 11·26 cubic centimeters. 3. On what basis is the musical scale constructed, and how are the proportional numbers $\frac{9}{8}$, $\frac{5}{4}$, $\frac{4}{3}$, etc., determined? Is it by experiment and trial, or is it by numerical calculations? A. They bear the ratios to each other disclosed in the preceding answer. The scale was fixed by ear; its ratios have been determined since by experiment.

(2128) W. McC., E. D. B. & D. S. D. ask about papier mache, its manufacture, etc. A. Four parts of paper clippings may be boiled in water and mixed with 6 parts of whiting. This mass, after pounding, kneading, and rolling, can be made into objects by pressing and moulding. Sometimes flat articles are made by pasting together a large number of sheets of paper and subjecting them to pressure. Often glue or gum arabic is dissolved in the water along with the pulp. To render it fireproof 10 per cent of tungstate of soda may be added to the water, but it is hardly needed. To make it waterproof, varnish when thoroughly dry, and heat in an oven. Where moulds are used they should be oiled. Pulp from the paper maker is a good body for papier mache.

(2129) F. H. N. & S. A. Z. ask (1) how to make printing ink of different colors. A. As a medium, use linseed oil 6 quarts, heat until the vapor which can be ignited is given off, when remove at once from fire and stir. At intervals cover the vessel, withdraw samples, uncover and light again. When of proper consistency so as to draw out into strings 1½ inch long, it is extinguished and 6 pounds of resin and next 1¾ pounds of soap are dissolved in it. The operation is dangerous and should be performed by an expert, and out of doors or in a shed. With this a proper pigment is ground, lampblack with 3 ounces Prussian blue or indigo for black. Instead of above the following may be used: Balsam of copaiba 9 ounces, lampblack 3 ounces, indigo 1¼ ounces, Indian red ¾ ounces, turpentine soap 3 ounces. For other colors use other

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pigments. 2. How to tell the positive and negative wires of an electric light current. A. Immerse the ends of the copper wires in dilute sulphuric acid. Gas will be given off from the wire corresponding to the connection to the zinc pole of a battery. 3. How to make flash light powder for photography. A. Simply sprinkle 15 grains of magnesium powder on a layer of gun cotton about a quarter of an inch thick and twice as large as a silver dollar. Set it on a dust pan. Place the pan on a step ladder about five feet from the floor. Connect a strip of gun cotton to the main bulk and ignite with a match. For further information on printer's ink we refer you to Workshop Receipts, 1st and 2d series, which we can supply for $2 each.

(2130) E. D. B. asks: What cohesive vehicle is put in emery wheels that run in water? A. Various materials may be used, such as vulcanite, shellac, and other resins, etc.

(2131) G. L. asks for the latest formula for developing dry plates. Also for a formula for fixing and toning solutions. A.

Developer.

No. 1.

Eikonogen	1 oz.
Sodium sulphite	2 "
Warm distilled or rain water	32 "

No. 2.

Carbonate of potash	1 oz.
Water	3 "

To two ounces of No. 1 add one ounce of water, immerse the plate in this, and should it develop too slowly add one or two drops of No. 2, continuing the addition a little at a time until the negative acquires the full amount of detail and density.

Toning Bath for Silver Prints.

Chloride of gold	1 gr.
Acetate of soda	24 "
Carbonate of soda	4 "
Warm water	8 oz.

Let it stand two days before using. To strengthen it add 1 grain of gold and twenty-four grains acetate of soda.

Fixing Bath.

Water	32 oz.
Hyposulphite of soda	5 "
Carbonate of ammonia	1 "

(2132) H. W. H. writes: Would you outline in Notes and Queries process of manufacture of oil of cedar, give commercial value and also direct me to where I could obtain a work giving detailed description of plant and process of manufacture? A. It is obtained by distilling the wood of the American cedar (*Juniperus Virginiana*), the shavings from lead pencil factories being used. This gives a white crystalline substance, as thick as butter. By pressing, the volatile oil is extracted, which is a thin limpid fluid, congealing at a low temperature, but rapidly drying by oxidation (resinifying), sp. gr. 0·9622 at 59° Fah., boiling point 519·8° Fah., freezing point 6° Fah. The subject is treated in a general way in Brannt's "Animal and Vegeable Fats and Oils." It is worth 75 cents a pound.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

April 1, 1890.

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Adding machine, J. F. Mays ... 424,932
Advertisements, etc., device for exhibiting, N. E. Hamilton ... 424,882
Air moistening apparatus, E. Mertz ... 424,652
Air ship, J. J. Pokorny ... 424,822
Alarm. See Fire alarm.
Alarm lock, G. J. Keller ... 424,886
Animal trap, H. E. Kelley ... 424,792
Arc light, J. Dulait ... 424,866
Artillery, mounting for field, T. Nordenfelt ... 424,496
Artist's kit, I. P. Favor ... 424,603
Auger, P. Miller ... 424,566
Axle check for vehicles, D. C. Funcheon ... 424,549
Axle, self-oiling car, R. P. Sholl ... 424,731
Axle, vehicle, F. Ulrich ... 424,585
Baling press, A. Wickey ... 424,840
Bar. See Crow bar.
Barrel blanks, machine for cutting gores in, J. W. Philp ... 424,821
Basin, settling, C. Delafield ... 424,542
Bath tub seat, E. Schoonmaker ... 424,730
Beehive, U. Baird ... 424,844
Belt, electro-medical, W. J. Shelton ... 424,827
Berth guard, J. A. Green ... 424,881
Bicycle, Doring & Siegert ... 424,864
Bicycle, S. M. Fay ... 424,870
Bit. See Bridle bit.
Blower, fan, M. Williams ... 424,696
Blower for stoves, adjustable, F. Keifel ... 424,559
Board. See Game board.
Boat, W. H. Patton ... 424,817
Boiler. See Steam boiler.
Boiler furnace, steam, M. V. Smith ... 424,829
Book, manifolding blank, G. H. Randall ... 424,499
Boots or shoes, manufacture of, G. W. Day ... 424,862
Bottle, mucilage, W. R. Cole ... 424,539
Bottle washer, C. H. Murphey ... 424,894
Bracket. See Clothes bracket.
Brake. See Car brake. Track brake. Vehicle brake.
Brick kiln, H. S. Hallwood ... 424,474
Bridle bit, C. C. Cole ... 424,538
Brush, tooth, I. Lichtenstein ... 424,716
Buckle, belt, C. & E. J. Deitsch ... 424,765
Buckle guard, G. D. Mosher ... 424,721
Buggy boot, Woodmansee & Klohr ... 424,588
Burner. See Lamp burner.
Burning fuel and utilizing the heat and gases, M. V. Smith ... 424,828
Button, J. R. Smith ... 424,733
Cable grip, E. S. Reid ... 424,935
Cable lifting device, J. Volk ... 424,520
Calculator, tabular, E. J. F. Quirin ... 424,574
Camera. See Photographic camera.
Camphor, apparatus for refining, W. V. McKenzie ... 424,615
Can filling and packing machine, T. Houlahan ... 424,885
Candle for killing insects, R. Atkinson ... 424,590
Canopy holder, R. F. Painter ... 424,572
Car brake, G. L. Fowler ... 424,773
Car coupling, J. Haish ... 424,473
Car coupling, C. H. Olds ... 424,655
Car coupling, H. Small ... 424,509
Car coupling, W. L. Smith ... 424,658
Car coupling, H. Sommerfeld ... 424,582
Car, freight, P. D. Whitehead ... 424,915
Car heating apparatus, W. Buchanan ... 424,459
Car motor, electric, E. M. Bentley ... 424,699
Car, railway, O. Harriman ... 424,475
Car, safety, J. W. King ... 424,678
Car, stock, G. D. Burton ... 424,598
Car ventilator, railway, O. Harriman ... 424,476
Cars, means for releasing grips on cable, J. H. Robertson ... 424,619
Cars, pipe coupling for railway, E. E. Gold ... 424,780
Card clothing, grinder for, H. E. Cunningham ... 424,763
Carpet fastener, O. D. Southworth ... 424,511
Carpet stretcher, F. B. Noble ... 424,495
Carpet sweeper, W. J. Drew ... 424,672
Carriage door, F. A. Bradley ... 424,701
Carriage, folding, T. M. McCarty ... 424,570
Carrier. See Cash carrier. Grip carrier
Cartridge, blasting, A. Palle ... 424,685
Cartridges, means for loading and capping, J. W. Carver ... 424,641
Case. See Packing case. Pencil case. Toilet case. Watch case.
Case lock, extension, H. F. Lane ... 424,486
Cash carrier, A. & A. Iske ... 424,789
Caster, ball, H. A. Dalrymple ... 424,467
Caster, stove, W. H. Vance ... 424,694
Cellars, automatic device for removing water from, G. Hoffman ... 424,553
Cesspool, F. L. Union ... 424,838
Chair, H. A. Dalrymple ... 424,466
Chairs, fan attachment for rocking, Arthur & Bamberger ... 424,589
Checkrein hook, O. Taber ... 424,624
Chopper. See Cotton chopper.
Christmas tree ornament, B. Wilmsen ... 424,916
Chuck jaw, E. B. Bailey ... 424,698
Churn, A. Daul ... 424,600
Churn dasher, B. F. Carson ... 424,669
Chute, coal, D. H. Henkels ... 424,785
Cigar wrapping machine, G. M. Hathaway ... 424,883
Clam roaster, G. B. Fowler ... 424,875
Clasp, J. A. Turnbull ... 424,516
Clock, alarm, A. M. Lane ... 424,797
Clock, double faced electric, E. W. Lindenau ... 424,929
Clock key, R. Ueltzen ... 424,630
Clock striking mechanism, A. M. Lane ... 424,796
Closet. See Water closet.
Cloth marking apparatus, Main & Wilson ... 424,717
Clothes bracket, folding, G. R. Morrison ... 424,569
Clothes pounder, E. B. Dreifoos ... 424,865
Clutch, friction, J. Walker ... 424,631
Clutch, rope, W. Leiter ... 424,560
Clutch, stop, H. V. Hartz ... 424,478
Coal and ore bins, discharge apparatus for, A. A. Strom ... 424,938
Coal conveyer gate, C. S. Schenck ... 424,937
Cock, stop and waste, H. J. Freudenfeld ... 424,774
Coffee pot, H. B. Cornish ... 424,671
Coffee pot, two-part, Munger & Cornell ... 424,807
Coffin fastener, C. E. Richards ... 424,618
Coin-operated apparatus, C. S. Batdorf ... 424,593
Collar fastener, horse, T. B. & W. A. Bomar ... 424,850
Colter, plow, J. Newmon ... 424,897
Comb, C. Felder ... 424,604
Combination gauge, W. B. Little ... 424,681
Concrete continuously, mould for moulding, E. L. Ransome ... 424,656
Copal, manufacture of artificial, E. Schaal (r) ... 11,069
Copying pad, P. E. Loree ... 424,930
Cotton chopper, J. H. Stanford ... 424,906
Coupling. See Car coupling. Pipe coupling. Union coupling.
Crab and fish trap, R. M. Franklin ... 424,548
Crowbar, H. Bowman ... 424,767
Cuff retainer or holder, W. L. Fullaway ... 424,777
Cultivator, H. Carrier ... 424,462
Curtain pole, C. W. Laurence ... 424,610
Cuspidor, J. J. Parsons ... 424,815, 424,816
Cutter. See Harvester cutter. Meat cutter. Pipe cutter.
Dental bridge, G. L. Curtis ... 424,924
Dental matrix retainer, J. W. Ivory ... 424,790
Derricks, device for turning the arms of, H. B. Arden ... 424,530
Die. See Interchangeable die.
Digger. See Potato digger.
Dish rinsing and drying crate, W. O. Demorest ... 424,863
Disinfectant cover for dry closets, etc., J. A. McOmber ... 424,811
Display frames, shoe rest for, J. Hoffman ... 424,555
Door mat, G. E. Eggert ... 424,867
Dropper. See Medicine dropper.
Drying starch or other solid matter, apparatus for, F. M. F. Cazin ... 424,760
Dust pan, G. A. W. Cage, Jr ... 424,461
Electric call, F. B. Wood ... 424,635
Electric circuits, safety device for, C. G. Young ... 424,665
Electric indicator, M. D. Porter ... 424,725, 424,726
Electric light, marine, A. G. Donnelly ... 424,544
Electric motor, L. Bock, Jr ... 424,535
Electric motor, L. T. Smith ... 424,734
Electric motor regulation, Bergmann & Scott ... 424,595
Electric switch, C. S. Van Nuis ... 424,739
Electric trap, F. Scherer ... 424,729
Electrical conductor, J. A. Barrett ... 424,751
Electrical heater, J. V. Capek ... 424,921
Electrode, secondary battery, J. F. McLaughlin ... 424,809
Elevator. See Ice elevator. Water elevator.
Elevator, S. C. Evans ... 424,869
Elevator, W. A. Sawyer ... 424,904
Elevator gate, J. G. Zeller ... 424,917
Embroidering machine, Birks & Cropper ... 424,846
Engine. See Gas engine. Steam engine.
Engine, A. Ball ... 424,450
Engine, J. M. Sailer ... 424,505
Eye bars, manufacture of, G. M. Heller ... 424,783
Eyelet setting machine, E. D. Welton ... 424,745
Fabrics, producing tucks on, L. Loeb, Jr ... 424,682
Farm gate, O. E. H. N. Reichling ... 424,576
Fastening for gloves, etc., B. Bernstein ... 424,754
Faucet, measuring, C. Skinner ... 424,691
Feedwater heater, J. C. C. Davol ... 424,764
Felt articles, machine for making wool, J. S. Tapley ... 424,661
Fence, H. C. Pratt ... 424,498
Fence pickets, device for wiring, D. Hershberger ... 424,884
Fence wrench, C. H. Van Epps ... 424,912
Fences, machine for resetting rail, P. M. Brown ... 424,855
Filter, W. D. Cummings ... 424,762
Filter, F. Lascar ... 424,679
Filter, rain water, N. H. Long ... 424,651
Filtering machine, J. A. Crocker ... 424,464
Fire alarm, automatic, C. A. & J. F. Cox ... 424,860
Fire alarm system, T. Johnson ... 424,558
Fire escape, J. Burt ... 424,460
Fire extinguisher for car stoves, S. S. Weinberg ... 424,743
Fire indicator or alarm, spring-actuated, S. D. Earl ... 424,545
Fish trap, W. B. Mumford ... 424,494
Folding table, E. R. Golder ... 424,879
Folding table, R. Smith ... 424,830
Force feeder, J. C. Riley ... 424,824
Frame. See Saw frame. Sewing machine frame.
Fruit gatherer, C. J. Bloom ... 424,455
Fruit gatherer, W. W. Hays ... 424,645
Fruit gatherer, J. W. Peck ... 424,934
Fruit picker, J. W. Graham ... 424,880
Fruit pitting and spreading machine, G. A. Fleming *et al* ... 424,771
Furnace. See Boiler furnace. Regenerator furnace. Soda recovering furnace.
Furnace, W. H. Strang ... 424,737
Furnace firepot, C. H. White ... 424,634
Fuse, safety, A. F. Andrews ... 424,449
Gauge. See Combination gauge.
Game board, G. Bixler ... 424,667
Game counter, F. J. Hall ... 424,551
Gas burning and heating apparatus, W. H. Bradley ... 424,852
Gas engine, D. S. Regan (r) ... 11,068
Gas mains, cut-off and relief apparatus for, J. C. Conroy ... 424,761
Gas mixer, fuel, W. G. Taylor ... 424,738
Gas trap for sinks, sewer, F. Henkel ... 424,784
Gate. See Coal conveyer gate. Elevator gate. Farm gate.
Generator. See Steam generator.
Girder, composite, J. D. Lazell ... 424,798
Glass bottles or like articles, mould for making, S. Washington ... 424,524
Glass, means for transferring molten, F. Schefold ... 424,825
Glass, means for transferring pots containing molten, F. Schefold ... 424,826
Glove fastener, E. J. Kraetzer ... 424,794, 424,795
Grain binder, P. Hanson ... 424,709
Grain binder, J. R. Severance ... 424,507
Grain conveyer, pneumatic, Barclay & Walker ... 424,838
Grain cradle, T. W. Orr ... 424,899
Grain meter, M. A. Kidder ... 424,483
Graphophone, J. H. White ... 424,914
Grating, J. B. West ... 424,525
Grinding machine, G. W. Brown ... 424,919
Grip carrier or hanger, J. Volk ... 424,521
Grip shoe, J. W. Dotson ... 424,644
Guard. See Berth guard. Buckle guard.
Gun sight, J. W. Carver ... 424,640
Hairpin, M. Cashin ... 424,670
Hame fastener, J. H. D. Everett ... 424,769
Hammer, power, F. W. Taylor ... 424,939
Harness pad, W. A. Bates ... 424,532
Harness pad, R. H. & J. Morrow ... 424,893
Harvester cutter, corn, J. Wade ... 424,522
Hat band, T. B. Cross ... 424,465
Hats, machine for attaching sweats and bands to, G. E. Brush ... 424,458
Heater. See Electrical heater. Feed water heater.
Hedge trimmer, J. E. Lowell ... 424,803
Hinge, E. G. Phillips ... 424,900
Hinge and door check, combined spring, J. W. Morris ... 424,613, 424,614
Hinge, coach, L. Ruel ... 424,504
Hoisting bucket, C. Pay ... 424,571
Holder. See Canopy holder. Horse tail holder. Opera glass holder. Paper holder. Parcel or bundle holder. Parcel strap holder. Pen holder. Photographic plate holder. Sewing machine spool holder. Ticket holder.
Hook. See Checkrein hook. Snap hook.
Horse boot, Dyer & Riick ... 424,767
Horse boot, L. M. Philo ... 424,573
Horse tail holder, W. F. Bidwell ... 424,453
Horseshoe, G. C. Edmunds ... 424,546
Horsehoes, machine for finishing cast, C. J. Le Roy ... 424,890
Hose reel, S. F. Reynolds ... 424,501
Hydraulic cylinder lubricator, J. H. Brookmire ... 424,456
Ice elevator and snow remover, J. S. Field ... 424,706
Ice or refrigerating machine, F. W. Wolf ... 424,746, 424,747
Incubator, B. W. S. Clark ... 424,599
Indicator. See Electric indicator. Fire indicator.
Ingot manipulator, Hemphill & Fawell ... 424,650
Ink for printing, lithographing, etc., O. G. Holt ... 424,556
Ink pad, E. Reynolds ... 424,657
Insulation, electrical, T. S. Reed ... 424,575
Interchangeable die, H. B. Anable ... 424,636
Iron. See Sad iron. Wagon bed iron.
Jack. See Saddle jack.
Jar. See Sirup jar.
Jar cover fastening, F. & E. Monier ... 424,720
Jewelry, F. X. Zirnkilton ... 424,749
Jewelry, hinge joint for, D. F. Adams ... 424,529
Joint. See Pipe joint.
Key. See Clock key.
Kiln. See Brick kiln.
Knitting machine, circular, J. E. Gearhart ... 424,877
Knitting machine, circular, Holt & Wrightson ... 424,787
Knitting machine, circular, W. H. Pepper ... 424,497
Ladder, step, E. Harter ... 424,782
Lamp, arc, R. H. Beach ... 424,752
Lamp burner, L. Zander ... 424,666
Lamp globe, gas or oil, G. Froh ... 424,776
Lamp, hanging, J. I. Johnson ... 424,712
Lamp, hanging, A. H. Jones ... 424,714
Lamp standard, W. C. Homan ... 424,711
Lasting machine, P. Cunningham ... 424,861
Latch, E. Richardson *et al* ... 424,902
Letters, etc., receptacle for gummed, H. Willson ... 424,526
Lifter. See Plate lifter.
Light. See Arc light. Electric light.
Lightning arrester, O. P. Loomis ... 424,562, 424,563
Liquids, apparatus for testing, T. Clement ... 424,643
Lock. See Alarm lock. Case lock. Nut lock.
Lock, J. Corbett ... 424,859
Locomotive, electric, J. F. McLaughlin ... 424,810
Locomotive engines and railway rails, device for drive wheels of, A. P. Tallmadge ... 424,627
Locomotives, guard rail for, J. A. Woodmansee ... 424,697
Loom stop motion, J. H. Thalmann ... 424,908
Lubricator. See Hydraulic cylinder lubricator.
Magnet, choking electro, L. Gutmann ... 424,606
Magnet, electro, G. D. Clarke ... 424,703
Mail matter, machine for stamp canceling and postmarking, M. V. B. Ethridge ... 424,868
Mat. See Door mat.
Measure, hatter's, H. L. Johnson ... 424,481
Measure, spouted, G. E. Raymond ... 424,901
Measuring alternating currents of electricity, method of and apparatus for, W. Lowrie *et al* ... 424,891
Meat cutter, J. W. Brown, Jr ... 424,758
Medicine dropper and eye pipette, W. F. Ware ... 424,662
Metallic matting, J. Adair ... 424,445
Meter. See Grain meter.
Mould, T. H. Mooney ... 424,892
Mop, S. W. C. Adams ... 424,750
Mortising machine, J. H. Blake ... 424,849
Motion from windmills, etc., mechanism for converting and transmitting, Smith & Kelly ... 424,610
Motor. See Car motor. Electric motor. Pressure motor. Railway motor. Water motor.
Motor, L. Beck ... 424,451
Motor, R. Solano ... 424,659
Nail machine, automatic cut, L. E. Curtis ... 424,925
Nap bats, apparatus for forming, Judd & Mallory ... 424,791
Needle threader, C. E. Van Norman ... 424,518
Nut lock, Brock & Vetter ... 424,853
Nut lock, C. Brown ... 424,457
Nut lock, P. C. Thompson ... 424,836
Nut wrench, D. Steiner ... 424,583
Obstetrical forceps, J. R. Brown ... 424,702
Obstetrical forceps, J. N. Reimers ... 424,689
Oil from a supply reservoir to tanks, means for conveying, J. Burns ... 424,596
Oil pipes, means for detecting, leaks in underground, J. Burns ... 424,597
Oil testing machine, W. S. Boult ... 424,536
Opera glass holder, Levy & Gerow ... 424,611
Ordnance, recoil check for heavy, W. Anderson ... 424,448
Ordnance, etc., utilization of fluids in checking recoil in, J. A. C. De Latouche ... 424,889
Ore pulverizer, T. H. Tregoning ... 424,515
Packing case, W. H. Mixson ... 424,567
Packing, metallic, W. I. Page ... 424,814
Packing, piston, F. D. Child ... 424,856
Packing, piston rod, F. D. Toucey ... 424,662, 424,909
Pad. See Copying pad. Harness pad. Ink pad.
Paddlewheel, J. Cobban ... 424,704
Paint, Morris & Gent ... 424,653
Pan. See Dust pan.
Paper holder and cutter, roll, T. P. Chapman ... 424,923
Paper holder and cutter, roll, H. Hubbell ... 424,788
Paper sacks, machine for making, A. Weidenbusch ... 424,742
Paper winding machine, G. Kaffenberger ... 424,608
Parcel or bundle holder, G. B. Rowe ... 424,578
Parcel strap holder, G. M. Morris ... 424,806
Parchmentized fiber, manufacture of rods of, R. P. Frist ... 424,876
Pasting machine, G. A. Fullerton ... 424,472
Pen holder, J. I. Harris ... 424,552
Pen holder, magnetic, E. A. Hill ... 424,786
Pencil case, magazine, M. Schreiber ... 424,621
Perforating machine, J. Caster ... 424,759
Perforating wheel, Jensik & Stoll ... 424,676
Photograph burnishing machine, W. G. Entrekin ... 424,768
Photographic camera, W. B. Luce ... 424,564
Photographic plate holder, P. Chouteau ... 424,857
Piano damper, C. C. Wickham ... 424,841
Picker. See Fruit picker.
Pin. See Hair pin.
Pipe coupling, R. G. Chase ... 424,463
Pipe cutter, M. V. B. Hill ... 424,710
Pipe expanding tool, F. I. Lessard ... 424,800
Pipe joint, F. I. Lessard ... 424,799, 424,801
Pipe plug, soil or other, J. A. Rossman ... 424,690
Planter, corn, J. Admire ... 424,447
Planter, corn, A. Davis ... 424,541
Plaster, J. E. Turner ... 424,517
Plate lifter, S. Waterman ... 424,913
Plow, W. T. Dodd ... 424,470
Plow, A. F. Molitor ... 424,492
Plow fender attachment, J. W. Heaton ... 424,647
Plow, reversible, E. S. Gero ... 424,926
Plug feeder or plug cock, automatic, J. J. Powers ... 424,688
Pot. See Coffee pot. Furnace fire pot.
Potato digger, J. N. Baker ... 424,531
Potato digger, G. Goodrich ... 424,781
Power. See Tide power.
Press. See Baling press. Telescopic press.
Pressure motor, fluid, D. E. Kempster ... 424,609
Pressure regulating apparatus, N. C. Locke ... 424,561
Printing, etc., O. G. Holt ... 424,557
Printing machine, dial, E. S. Bradford ... 424,851
Prints on triangular sheets, production of, W. Ottman ... 424,813
Prison, C. Schoenfeld ... 424,936
Pulley, F. M. Powell ... 424,687
Pulp, forming smooth surfaces on wood, G. C. Towle ... 424,513
Railway, cable, G. R. Ratto ... 424,500
Railway casting, E. Samuel ... 424,728
Railway, electric, E. M. Bentley ... 424,845
Railway, electric, F. O. Blackwell ... 424,848
Railway, electric, R. M. Hunter ... 424,928
Railway, electric, W. H. Knight ... 424,887, 424,888
Railway, etc., elevated, Turner & Taylor ... 424,693
Railway motor, electric, F. A Perret ... 424,818
Railway motor, electric, C. J. Van Depoele ... 424,911
Railway sanding apparatus, H. C. Noble ... 424,933
Railway signal, automatic, Scotland & Brink ... 424,506
Railway tie, A. Kimber ... 424,793
Railways, automatic cable lifter for cable, J. C. H. Stut ... 424,832
Railways, automatic tension device for cable, J. C. H. Stut ... 424,833
Railways, contact device and switch for electric, C. J. Van Depoele ... 424,910
Railways, operating electric, R. M. Hunter ... 424,607
Railways, suspended switch and traveling contact for electric, C. J. Van Depoele ... 424,695
Range, stove, J. H. Taylor ... 424,628
Razor, safety, B. Vom Eigen ... 424,601
Reel. See Hose reel.
Refrigerator, T. H. Weirich ... 424,744
Refrigerator door fastener, A. W. Black ... 424,847
Refrigerator pipe attachment, F. W. Wolf ... 424,748
Regenerator furnace, J. A. Herrick ... 424,480
Rice hulling, cleaning, and polishing machine, E. C. Engelberg ... 424,602
Riveting machine, R. A. Carl ... 424,668
Rubber tired wheel, P. J. Beiersmith ... 424,452
Ruching, C. B. Simpson ... 424,732
Sad iron, J. A. Berlin ... 424,753
Saddle, O. Taber ... 424,626
Saddle, Taber & Low ... 424,622
Saddle, harness, Taber & Low ... 421,623
Saddle jack, R. Garrett ... 424,674
Saddle tree, O. Taber ... 424,625
Safety machine, Hahn & Schroder ... 424,550
Sand moulds, apparatus for forming, W. B. Sterrit ... 424,831

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Sash balance, G. E. Taylor 424,940
Sash fastener, J. S. Biery 424,454
Saw filing machine, W. H. Penrose 424,724
Saw frame, adjustable, S. Hale 424,927
Sawmill dog, D. C. Prescott 424,727
Sawmills, variable feed for, M. I. Welch 424,663
Scales or other coin-actuated mechanism, coin-released weighing, A. H. Fancher 424,770
School seat, J. R. Johnson 424,713
Scraper, road, M. S. Rexford 424,823
Screen. See Window screen.
Screw machine, metal, S. L. Worsley 424,527
Screw-threading machines, pipe elbow holder for, F. F. Voigt 424,519
Seal, L. A. Foote 424,772
Seat. See Bath tub seat. School seat. Vehicle seat.
Seeds, compound for treating, J. M. Young 424,843
Sewer sheathing driver, N. E. Green 424,708
Sewing machine, L. L. Miller 424,490
Sewing machine buttonhole attachment, D. Mills 424,804
Sewing machine frame, J. M. Brosius 424,854
Sewing machine spool holder, J. H. Fletcher 424,874
Shafts in soft earth, means for sinking, T. J. Phillips 424,819
Shafts in soft earth, sinking, T. J. Phillips 424,820
Shell, dynamite, E. Stern 424,736
Shell for high explosives, J. G. Justin 424,482
Shingles automatically, machine for packing, H. L. Fehlberg 424,673
Shoe or glove fastener, J. C. Murray 424,683
Shoe case corner, J. Hofman 424,554
Signal. See Railway signal.
Signals, interlocking apparatus for operating, Koenig & Stupakoff 424,485
Singletree, P. Fisher 424,873
Sirup jar, E. Haas 424,675
Slate, draw-leaf, S. Marks 424,931
Sled, coasting, C. H. Dickson 424,469
Snap hook, J. P. Anderson 424,637
Snow plow, I. Osgood 424,616
Soda, recovering, H. Blackman 424,756
Soda recovering furnace, H. Blackman 424,755
Soles or like forms, machine for cutting, D. F. Hartford 424,477
Spike machine, A. Welsh *et al* 424,586
Spoons and forks, making, W. Rogers 424,503
Spring. See Wagon spring.
Spur, F. Monier 424,719
Stairway, spiral, R. O. Belles 424,533
Stamping mechanism, hand or other, E. H. Rogers, Jr 424,502
Stand. See Tub stand.
Steam boiler, J. L. Heald 424,646
Steam boiler, W. H. Smith 424,735
Steam boiler, A. Worthington 424,528
Steam engine, G. H. Adam 424,446
Steam generator, N. H. Tenney 424,629
Steam generator, N. P. Towne 424,514
Steam trap, E. E. Gold 424,779
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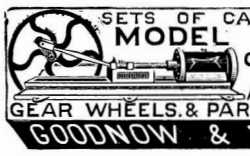

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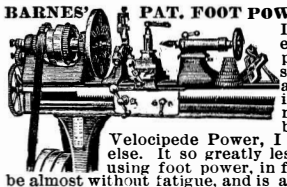

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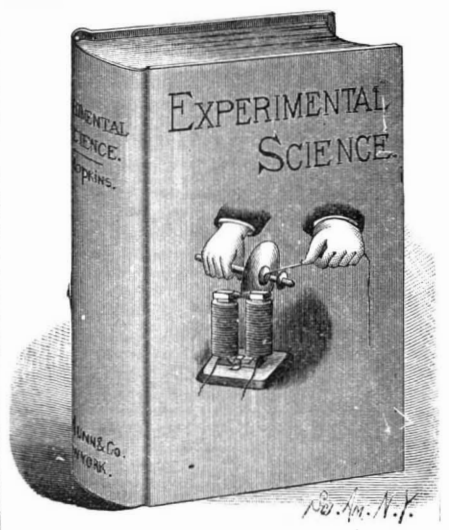

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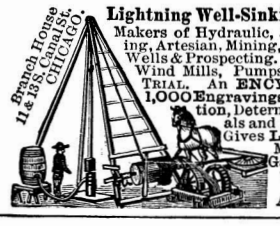

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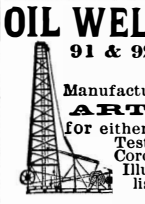

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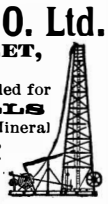

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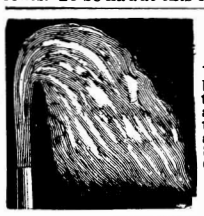

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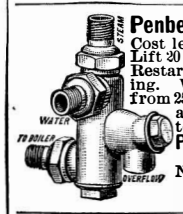

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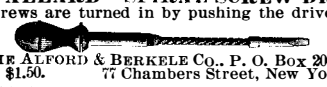
$1.50  $1.50
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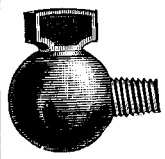

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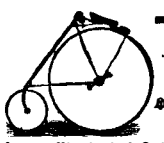

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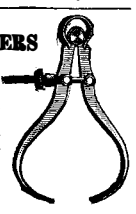

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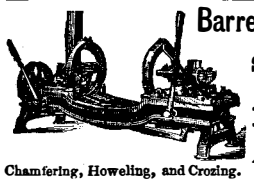

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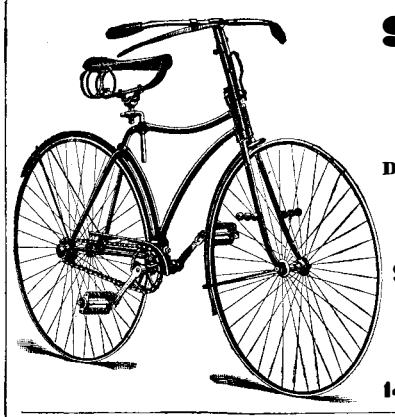

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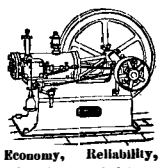

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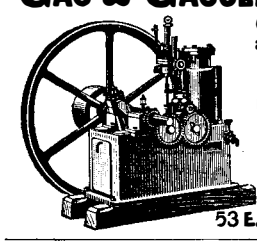

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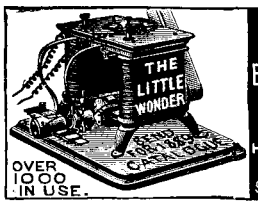

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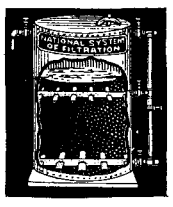

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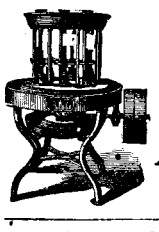

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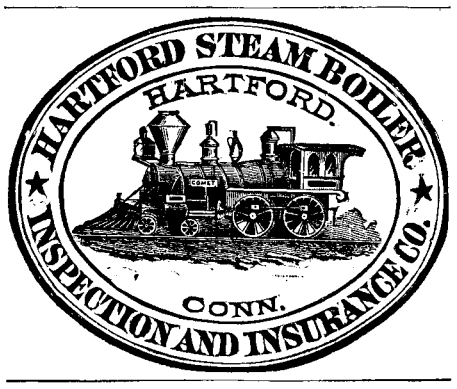

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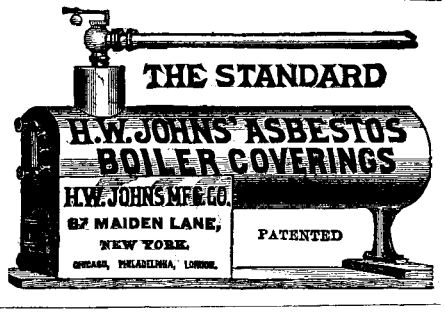

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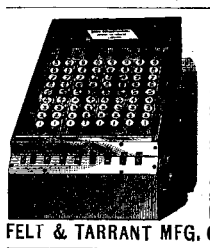

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